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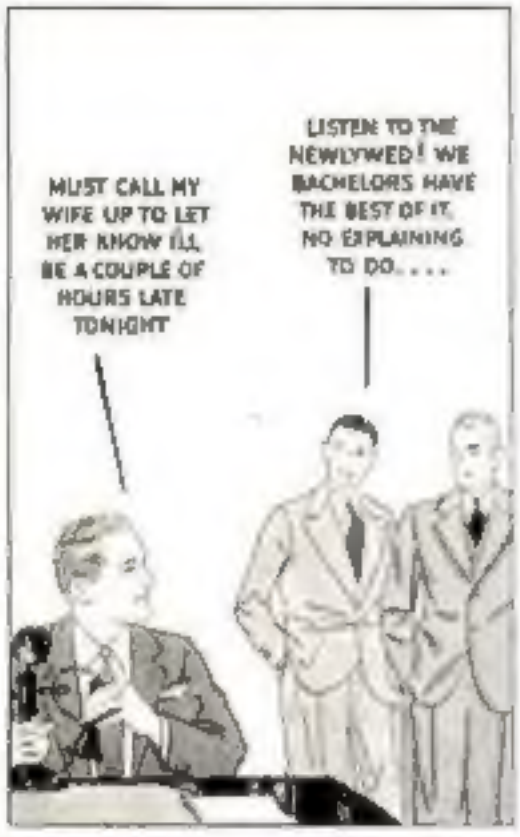

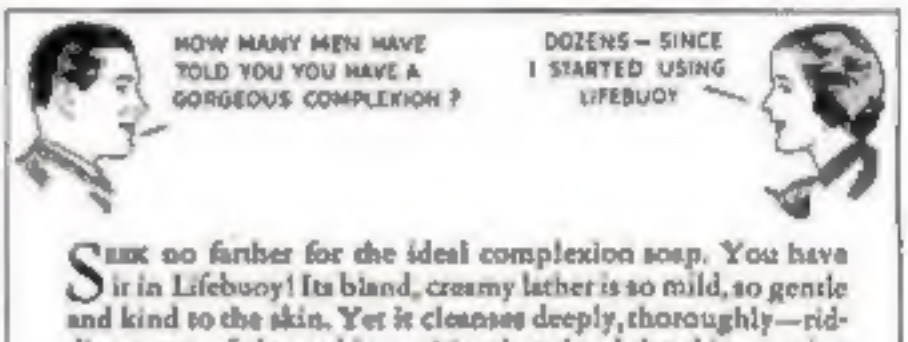

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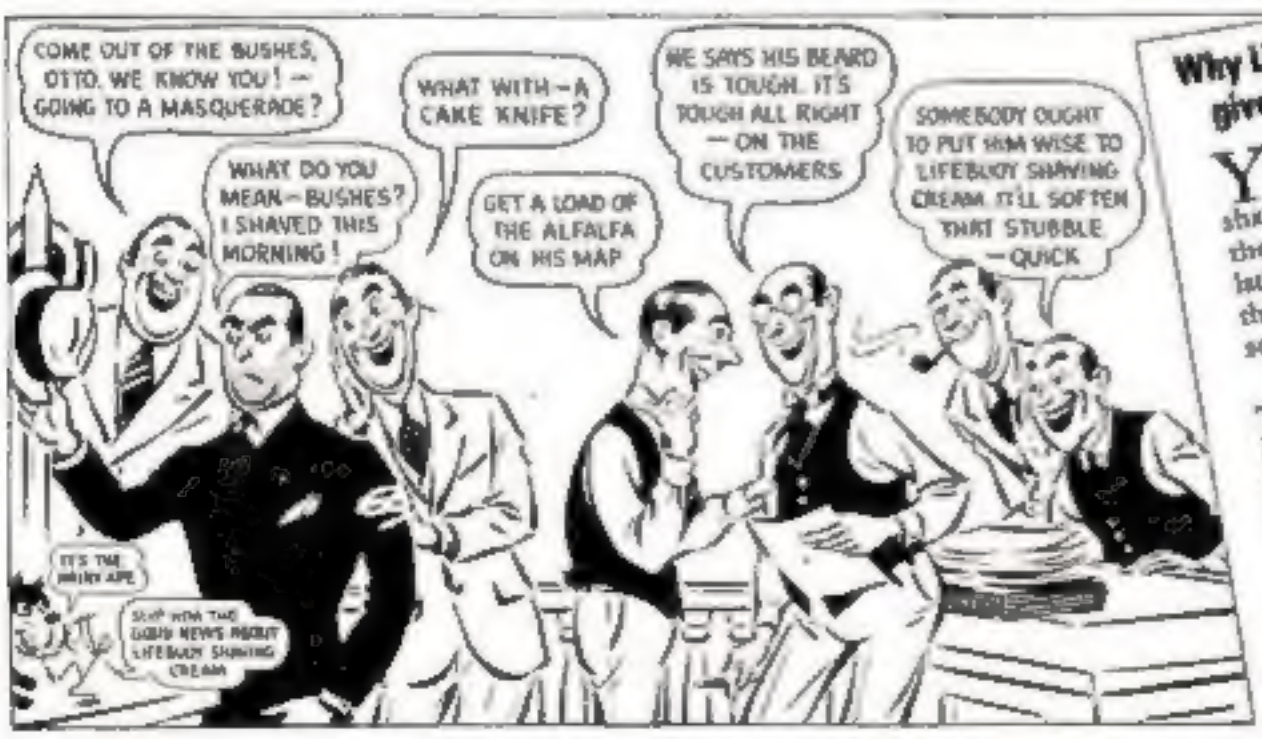

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To my Valentine

You may combine the qualities
of Samson and Clark Gable . . .
You might be able to provide
silk, satins and rich sable;
But just the same a man like you
can't satisfy my craving.
It's high time someone told you that . . .

You can't get by without shaving *a friend*

Bad meter, but worth remembering

Course Valentines sometimes hurt your feelings, but many of them teach important lessons. Here's one for every man who is careless about shaving. If you know one who neglects his beard—appears in public with stubble on his face—why not do him a real favor by mailing him this Valentine? It might do a lot of good. For apparently some people still don't realize that bristles are repulsive—make a man look untidy, ill-kept and often lose him the respect of others.

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By
R. M. BOLEN
Secretary, Popular Science Institute

Insulation can be poured into the walls of a house, as shown at right, simply by opening holes in the walls large enough to admit the pipe through which the material is forced. Below, fill-type insulation is being blown into attic floors to prevent loss of heat through roof

Cutting Down Your Fuel Bill

WHERE dollars and cents are concerned, the average home owner usually is a good business man. He bargains for the best in repairs, saves in gas and electricity, and buys only where quality is high and prices low. Yet, in two cases out of three, he ignores hidden leaks in his heating system that are robbing him of at least a dollar every winter week.

In most homes, fully fifty cents out of every dollar spent for taxes and general operating expenses goes for heat. Figured in cold cash, winter heating is an expensive proposition, but it can be made less expensive if precautions are taken to conserve it and get the most in comfort for every ounce of fuel.

Assuming that you have licked the fire-box losses in your furnace (P.S.M., Nov. '34, p. 6), your fight against fuel waste is well under way. However, other tricks, equally simple, will help you to slice even more from your yearly heat bill. First of all, it is false economy to shut down your fire so completely at night that the house is thoroughly chilled by morning. Tests show that fuel is wasted whenever a home is allowed to cool more than ten degrees below its normal temperature. To conserve the heat and allow your furnace to operate at a minimum, be sure that your sleeping rooms are well shut off from the rest of the house and lower the window shades in the remaining rooms to prevent the heat from escaping too rapidly through the window panes. A good thermometer hung in the hall will help you to regulate your furnace so that it is operating well within the efficient ten-degree temperature drop.

If your heating system is of the steam, hot-water, or vapor type, pay particular attention to your radiators. A mere one eighth inch of dust on the coils can account for a twenty-eight percent loss for that particular unit. Even the question of paint has a bearing on radiator efficiency. Contrary to popular belief, metallic paints rob considerably more heat than non-metallic paints, while black is a far more efficient color than white.

Should you find that one room in your house is always cold while another is unbearably hot, try switching the radiators. The exchange may strike a balance. Also, remember that most radiators are sectional, making it possible either to add or remove single sections to supply more or less heat. Of course, before making any radical changes in the system it will be best to find out something about the capacity of your furnace. In most cases

your heating contractor can furnish this information.

With pipe insulation selling for as little as twenty cents for three-foot lengths, there is little excuse for the heat that escapes from bare steam or hot water pipes. Losses, which generally run high at this point in a system, can be reduced as much as ninety percent by the installation of modern one-and three-eighths-inch sectional pipe insulation. Elbows and valves can be protected with asbestos furnace cement, obtainable at less than a dollar for twenty-five pounds.

IF OUR homes were built like thermos bottles, our heat-loss worries would end with the furnace and its system of air ducts or pipes and radiators. Unfortunately many homes, even though sturdily constructed, have no more holding power than a sieve where heat and cold are concerned. More than one quarter of the heat delivered by a furnace can be lost through faulty doors, windows, walls, and roof.

Three roads of escape exist at the windows and doors alone; cracks where the door and window frames meet the wall, clearances between the doors or sash and the frame, and the glass window panes themselves.

The first point of attack should be the needless cracks between the doors or windows and the wall. If desired, a commercial caulking compound can be obtained from your paint dealer or you can make your own by mixing paste white lead (6 oz.), dry asbestos (9 oz.), whiting (½ oz.), linseed oil (1 gill), and enough lampblack or other pigment to give the compound the desired color. This can be stuffed into the openings.

TWO general types of weather stripping are available to the home owner who wants to eliminate the heat-stealing drafts that seep in through the necessary loose-fitting joints between windows and doors and their frames. Although felt or rubber is the least expensive and easiest to apply, metal weather stripping is entirely within the amateur woodworker's scope and once in place lasts forever.

As for the third road of escape, the glass windows themselves, double sash or storm windows will invariably stop the loss. By forming an air space, they prevent the conduction of outside cold and inside heat. In most cases, they need not be applied to every window in the house but merely to those facing to the north or northwest.

To prevent the loss of heat through walls and roof, insulation is the only solution. No matter how well constructed your house may be, most ordinary building materials are good conductors of heat, passing on to the outside air a great deal of the costly warmth.

For convenience, insulation is now available in three general forms: Board, consisting of easily sawed and nailed materials in rigid sheet form; mats or felts (sometimes referred to as "bats"), flexible sheets of fibrous material; and fills, a loose form of insulation that generally is blown or poured into the hollow spaces between the studs of a wall or the beams of a floor.

Our Readers Say

Real Left-Handed Screw Found in Old Stagecoach

You published a wisecrack from G.S.L., Newcastle, Australia, about left-hand screws. Now, I not only know that there are such screws, but actually have some taken from an old stagecoach. They are three inches long, seven sixteenths of an inch in diameter, and must be turned left to tighten. You illustrated his letter with a kangaroo laughing, but I think the last laugh will be more like a prairie-dog laugh when he sees that we of the American prairies know our threads — at least, we can see a left-hand screw when it is one, and don't need any other than a right-hand driver for it, either. Another thing: almost all East Indian jewelry is made with left-thread screws. I was there six years ago and I know it to be a fact as I have quite a collection of them. Why doesn't G.S.L. tell us some news from his part of the world, or send us a boomerang. That laugh of his is sure going back.—W.C.K., Lamberton, Minn.

A Photographer Replies —In the Negative

In answer to the letter of the girl mechanic, M.D.M. of St. Augustine, Fla., suggesting that you give up the photography department, I say, "Nothing doing." Automobiles, airplanes, and Gus of the Model Garage are all good, but photography is the hobby of millions. Look at the business done by the finishing plants. You can carry a camera under your arm and develop your pictures in the bath room. Photography as a hobby is within the reach of every one and the results last a lifetime. Let's have some new tricks—the use of better cameras and ways to take better pictures. It was photography that sold this magazine to me three years ago and I certainly hope you will continue it along the lines suggested above so we can keep on going ahead.—G.A.J., Norwich, Conn.

Strange Red Ring Forms Around Oriental's Sun

Will you please give space in a corner of Our Readers Say page to this description of a "freak of nature"? The other day a friend of mine was so fortunate as to witness a curious heavenly phenomenon. At 12:30 p.m. the sky was somewhat cloudy. He observed a ring of a reddish color forming around the sun, a spectacular scene which lasted for a length of time. Subsequently, a gradual transformation of the original color into a pale blue took place. Could any of the readers of Popular Science Monthly satisfy my curiosity with a scientific explanation of this rare phenomenon (if, indeed, it is rare)?—S.M.G., Deoli, India.

Science Teacher Asks for More about Electricity

I saw a letter from L.B., Utica, N. Y., in a recent issue of Popular Science Monthly, asking for more electrical experiments. I, too, should like to see a series of articles on arcs, electromagnets, transformers, resistances, toy motors for direct and alternating currents, and other electrical experiments that would be of interest to high-school students. I have charge of the science department in the Mountain Home public schools and your magazine has certainly been a help to all my science classes. I have a class studying electricity now and another will be studying it soon. I'm hoping that you'll have a series of articles coming along in time to aid the second class.—L.C., Mountain Home, Ark.

"Black Lightning" Really Violet, His Photo Indicates

I was interested in the item in your department, Here's the Answer, under the heading "Black Lightning." In 1919 I made a photographic exposure during a summer electric storm in New Mexico. On developing the negative I found two streaks of lightning which ended in a different color from the one in which they began. As the film was of the old style, which is little sensitive to red, I assume that the light was a deep violet. As a matter of fact, I remember that the flashes that day were mostly of the lavender and purple kind, instead of the yellow and white. The darker the purple, the more transparent that portion of the film, as in that part the purple rays obstructed the brighter ones illuminating the background, so that they could not reach the camera lens. That there are dark or invisible rays has, of course, been demonstrated in infra-red photography, and I do not doubt that a film sensitive to red would have shown many more ray recordings, which would have printed out almost black. This is what gave rise to your correspondent's misconception about "black lightning."—H.B., Riverside, Calif.

He Wants Small Models of Crack Atlantic Liners

I have been greatly interested in Mr. Gommi's instructions for building small ship models. I built the *Aquitania* from his plans and the result is a beautiful miniature reproduction of that famous liner. Now I must appeal to you for assistance in building a set of the crack Atlantic liners, for which I should like the plans for building models of the *Leviathan*, *Bremen*, *Rex*, *Mauretania*, and *Britannic*, so that the set, when completed, could be put into a case and would make a very interesting and attractive group. I might mention that we hold annually an arts and crafts exhibition, and it is my intention with your assistance to enter a group of models of famous modern liners.—C.S.B., Sydney, Australia.

A Reader Makes a Design for the Millennium

There are certain manufacturers who ought to be strung up for not doing their share towards making life more enjoyable through the medium of their products. What am I driving at? Well, things like these: Why aren't all dry-goods materials pre-shrunk so that they'll remain the same size after washing? Why aren't all buttons sewn in place with strong thread so they'll stay put? Why doesn't my radio have a volume control that really controls the volume? Clocks should be made roach- and insect-proof. Women's watches are ridiculously designed, with the dial so small it takes a microscope to read the time. Most mail boxes and in-the-door mail slots are too small to take care of large pieces of mail like magazines, without folding and damaging them. Why should it be necessary to use a crowbar to open a bus, train, or trolley window? Tool manufacturers would do well to make tools for farmers and craftsmen of a light and rust-proof metal or alloy. And why aren't blocks and other pulleys so designed as to permit the use of a knotted, or at least a neatly spliced, rope? Also it should be a criminal offense for a maker of men's pants to put in them pockets that are not made of strong material. These are only a few of the billion-and-one "minor" things that would vastly improve living.—A.V., New York City.

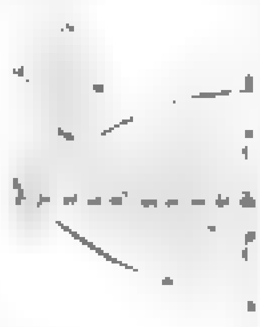
He Travels So Fast He Splits Himself in Two

While we just can't say how it came about, my brother and I got to talking about time and began to figure that if anything could be projected at a speed of 25,000 miles per hour, it would circle the earth in one hour. Increase this speed sixty times and the earth would be circled in one minute. Increase this speed sixty times and the earth would be circled in one second. Again increase it sixty times and the journey would be made in nothing flat. Increase this speed sixty times again and you would gain one second, or in other words, you would get back one second before you started. It would appear then that it is only necessary to travel at the requisite speed to gain any amount of time you want. Suppose one took such a journey and gained one hour. He could come back to where he had been one hour before, and observe himself. When did the split occur? He could prevent himself from

starting, but if he did so, he could not be there to prevent himself from starting or to meet himself, which is absurd. Can any kind reader point out the fallacy?—L.S.H., Philadelphia, Pa.

Here Is How One Reader Trisects Any Given Angle

I HAVE noticed continued interest among your readers in the subject of trisecting an angle. I found in a textbook a problem with its answer given as an equation in polar coordinates called the trisectrix and said to be the locus of the vertex C of a triangle whose base AB is fixed and which has the angle A=2C. I tested it out and found it to be true if you place the base AB on the polar axis between the origin and point a. That method didn't satisfy me, however, because the legs of the triangle shrink for given angles close to 180 degrees. I evolved a similar plan in which the legs do not shrink. It employs specially drawn curves, one of which is a function of sine of half the angle, and the other (almost a straight line) a function of one sixth of the angle. Both are sine curves. The diagram shows how it is done. Given any angle LQN (less than 180 degrees) and the specially drawn lines indicated. With Q as a center and a radius of two inches, draw the arc LMN and the chord LN. Bisect the angle to obtain the center line QM. Place the chord LN perpendicular to the center line of the special figure at the position where the ends of the chord touch the lines AB and AE. The points where the chord cuts the lines AC and AD are the projections of the true points of trisection along the arc LMN. [illegible] draw lines parallel to the center line through both points. Where these lines cut the arc we have the points of [illegible] the arc, and consequently the angle, into three equal parts. Always use a two-inch radius, unless you enlarge the special figure as you increase the radius.—W.F.H., Detroit, Mich.

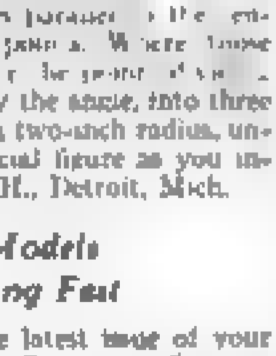


His Collection of Models Seems to Be Growing Fast

I'M JUST finishing the latest issue of your extra-good magazine, POPULAR SCIENCE MONTHLY. Keep up the dope on ship and coach models. I've built, since May, 1935, the *Texas*, *Indianapolis*, *Hartford*, *Manhattan*, *Sea Witch*, Diamond Tally-Ho (Concord stagecoach), and Cody Coach. I am now starting on the *Swallow*. Give Capt. Armitage M[illegible] my best regards.—J.A.S., Baltimore, Md.

Solution of Right-Angled Triangle Problem Thirty-five Centuries Old

THE solution of the "Extra Square Inch" problem showed how [illegible] can sometimes be used as [illegible] for [illegible] the areas not easily solved by other methods. A [illegible] of this is pictured in the accompanying figures, which are said to have been found [illegible] by [illegible] and believed to date back to 1600 B.C. The two large squares are equal and the right triangles are equal by construction. The result proves that the square on the hypotenuse of a right triangle is equal to the sum of the squares on the other two sides. It also proves graphically that $(a+b)^2=a^2+2ab+b^2$. I can't understand why this proof is forbidden in our textbooks on geometry.—C.W.B., Crockett, Calif.



Explicit Rules For Fixing Your Erratic Old Clock

IN a recent issue of POPULAR SCIENCE MONTHLY, G.S.C., of Pittsfield, N.H., asks for information on repairing alarm clocks. It is just possible that I can give him the low-down on clock repairing, as I have repaired, in the last fifty-five years, [illegible] watches and more than that number of clocks. First, get the works out of the case by taking out all the screws in sight. Then, with a [illegible], push out the back. If it [illegible] doesn't come out, don't use force, just hold it up and jiggle it. Let on that you don't want it out, and it will fall out. Next, find out what ails the clock before you fix it. If the mainspring is busted, put in a new one. Or, you can wind a fish line around the arbor shaft, hang a brick on it, or a weight, and nail the works to the smokehouse door (this method has been known to work). Now check up on the train. Start on the barrel, then the center wheel, third, fourth, and escape, down to the pallet fork and arbor. Observe the amount of end and side shake and correct it to one one-hundredth micrometer. Be sure [illegible] perpendicular and tight. Note the degree of draw on the entering pallet, the amount of lock on the discharge, and the end shake of the balance staff. See that the cones are sharp and polished with [illegible]. Now observe the action of the guard pin, which must be [illegible]. [illegible] the [illegible] when the [illegible] are adjusted to the escapement. Now observe the hairspring and see that it is centered and true. See also that the outside coil vibrates exactly between the curb pins. Next, put it in beat by rotating the collet on the staff. If the clock still won't run, don't [illegible] it [illegible] refuses to run, boil it in vinegar. If this does no good, take it all apart, but in putting it together don't get the mainspring in upside down, for that would cause it to run backward. If by this time you have decided that you are too busy to fix the clock, put all the pieces into a grape basket or milk pail and cover it well so that the neighbors will think you are carrying eggs. Sneak into a jewelry store and explain in detail how the clock jumped off the top shelf of the whatnot and landed on the brick that holds the door open. The jeweler won't dispute what you say; he will just make the bill two dollars instead of fifty cents. The same rules go for fixing watches. Just because a watch is small is no reason why it can't run as fast as or faster than a clock. I have seen a very small watch beat a town clock by four hours in one night. Regulating a watch is easy. Just count its beats for three hours. It beats five times a second, 300 a minute, 18,000 an hour, 432,000 a day and 157,680,000 a year. If it misses two beats in three hours by correct count, turn the timing screw one ten-thousandth of a turn to the right. Heck, it's easy. Grab a monkey wrench and hop to it.—W.D.G., Essex, Iowa.

Know All Things, Says This Broad-minded Reader

HERE are some thoughts for the young fellows who want you to give your magazine over exclusively to their particular hobby. I am proud of possessing some knowledge of practically every science. The things one learns in early life will be of service [illegible] can remember them [illegible] in my [illegible] life in retirement, devoted [illegible] to research along varied [illegible] lines. I find use for all of the [illegible] I have wasted in the past, even in the prosaic labors of janitor, gardener and printer's devil in my early days. One cannot learn too much, or of too many different things. For success in the modern world, one must learn, analyze, and forget much. All fields of knowledge are related. Some knowledge of astronomy may help one in chemistry, in mathematics, in mechanics, and in any other field.—G.H.J., Los Angeles, Calif.

It's the Naturalists' Turn To Swallow their Words

WHAT does it take to make a thing a fact? Does nature have to put on a stage performance before a group of hot house scientists to prove it? I admire scientists and their work, but I have no use for those half-baked nuts who are always questioning the veracity of others who have had years of opportunity to observe the conduct of nature. Just because these fancy naturalists fail to see the same thing occur when they put in four hours [illegible] and go [illegible] nature [illegible] they are ready to denounce the testimony of persons who have had the experience of a lifetime. Yes, there are kinds of snakes that take their young into their mouths. Whether this is for protection or to swallow them is the snake's business, for I have even less use for a snake than I have for those nuts who try to measure the world with their tongues. Scientists—bah! When a lad, I chased snakes and was chased by them. Some snakeologists have stated that no snake can strike beyond its own length. I positively know this to be untrue. In the spring of 1910 I barely escaped being bitten when a small snake coiled and struck at me, clearing the ground for a distance of practically twice its length. Recently one of our know-it-alls, in a question column in a newspaper, gave this answer in regard to the hoop snake: "In all my wide experience I have found no definite proof that the hoop snake ever existed." And, of course, his experience and opinion carries more weight than the experience of thousands through the past centuries. We have people at Zion City, Ill., who know that the earth is flat by the same evidence. Well, so much for the snakeologists. Their wisdom gives me a pain.—F.P., Bloomfield Hills, Mich.

Urges War on Waste of Coal and Oil

WE PRIDE ourselves on our scientific inventions to promote efficiency and prevent waste. Yet we are very wasteful of two of our natural resources that cannot be replaced, coal and oil. I have yet to learn of one thing that is being done to conserve these resources. Why not require automobiles that cannot make a gasoline mileage fixed by law, to be junked? Why not require auto manufacturers to meet this gasoline mileage in their new cars?—F.W.Y., Newport News, Va.

What a Shock to China This Deep Hole Would Be

HERE'S a question a friend put to me recently: Where does the force of gravity end? Suppose I dug a hole right through the earth and then let a stone fall so that it would drop through the hole. How far would it fall, or, in other words, where would it stop falling? We could not find an answer and decided it appeals to your readers for help. [illegible] some articles on [illegible]. Your article [illegible] Current [illegible] was very interesting. I would like more articles of that kind.—G.P.O., Boewaran, Java.

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Fighting the Tides of the Golden Gate

In bridging the Golden Gate at San Francisco, engineers have tackled what is said to be the most difficult underwater construction job ever attempted. This photograph shows the immense fender, 1,100 feet from shore, that shelters the base of the southern pier from tidal action

POPULAR SCIENCE

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RAYMOND J. BROWN, *Editor*

The machine, invented by J. R. L. Cornish, center, is designed to be used in restoring a person to life after asphyxiation

Can Science Raise *the* Dead?

Amazing experiments, now being conducted by experts, indicate the possibility of starting the heart again after it has ceased to function

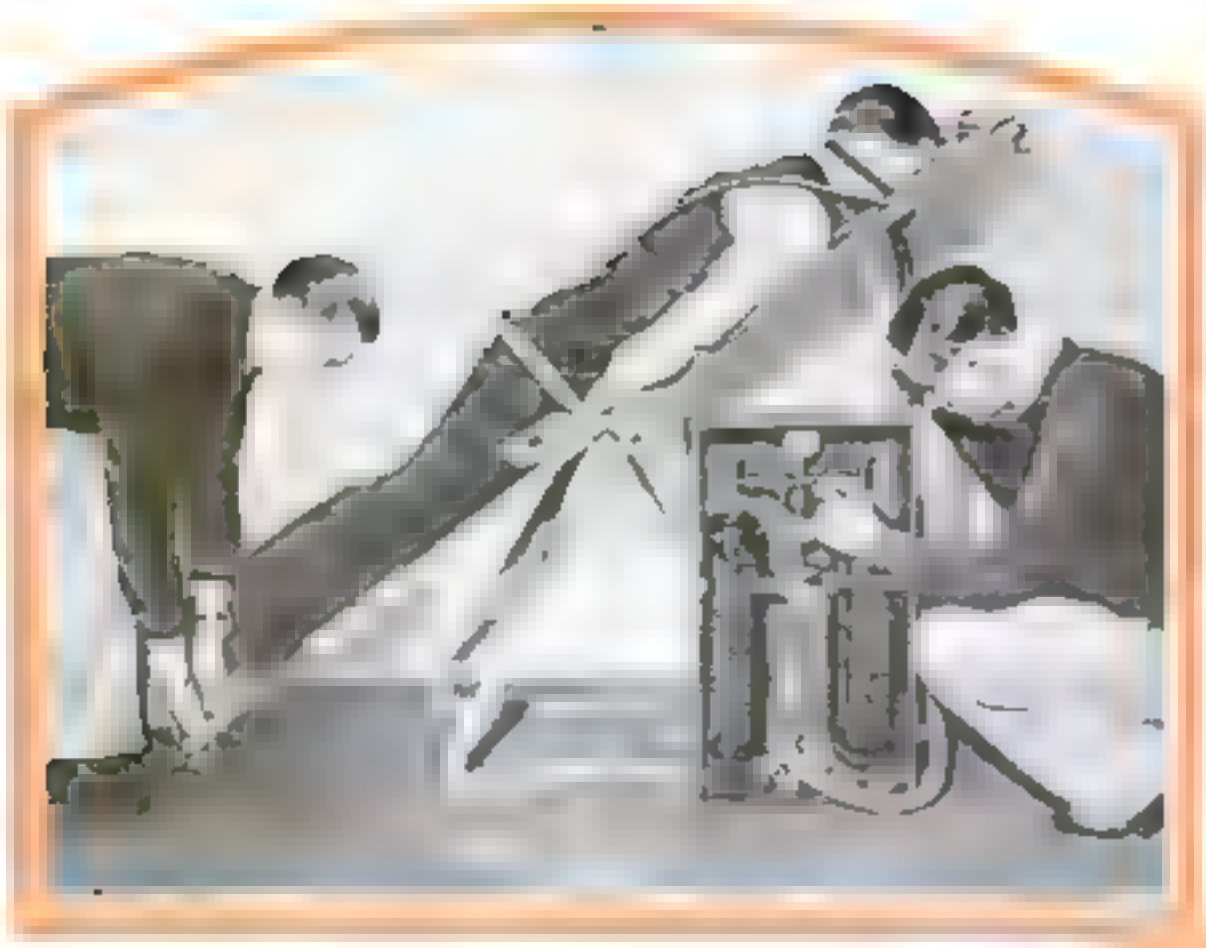
By J. I. FORD

IN A spotless laboratory three white-gowned men stand around an operating table. On a cloth lies a perfectly sound and healthy terrier. One of the men fixes a mask over the dog's muzzle while another turns the valve on a tank of nitrogen. Its supply of oxygen cut off by a gas that itself cannot support life, the dog after a time ceases to move. The muscles relax. The dog is dead.

Then, for what seems an eternity, the white-gowned men busy themselves with hypodermic needles and mysterious liquids in tightly corked vials. Four minutes pass. One of the men looks at his watch. Another fills a needle from one of the containers, then thrusts it into the chest of the dead dog until the point pierces the heart. An oxygen mask is placed over the dog's muzzle.

Nerves grow taut as the experimenters strain forward over the dog. A stethoscope is placed over its heart. The man using the instrument gives a cry of excitement. The heart has begun to beat. The dog, dead four minutes, is living again. In a day or two he will take food. Within a few weeks he will walk, run, play and obey commands.

As simply as this is realized a dream that has fascinated men for centuries. The dead has been brought back to life. True, it is only a



On another mechanical seesaw, use of which was recently demonstrated in London, persons apparently drowned are rocked back to life. The up-and-down motion induces an imitation of real breathing

dog, but Dr. Robert E. Cornish, the daring young California scientist who is thus able to thwart death, prophesies that a man, dying similarly of suffocation, can as easily be revived. In Baltimore and Cleveland, in Russia and Switzerland, other scientists, following other lines of research, make the same prophecy. Some of the miracles of the past will, they say, be duplicated one day by science.

At Johns Hopkins, in Baltimore, investigators have revived animals apparently killed by electric shock. They had been puzzled by the paradoxical fact that low current shocks sometimes cause death, while stronger shocks frequently do no more than momentarily interrupt heart action. Seeking an explanation, they found that light shocks disorganize action of the heart muscles, and these, unable to act in unison, cannot pump blood. The experimenters applied electrodes carrying a current of about one ampere directly to the heart of an unconscious dog. The counter-shock stopped the disorganized fluttering and the heart resumed its normal beat, restoring the dog to life."

Other investigators in Russia, using an artificial heart invented by Dr. Serge Brukhanenko, succeeded recently in bringing back to some semblance of life a man who had hanged himself. Declared dead for three hours by competent physicians, the suicide's body was hurried to the laboratory. There the surgeons slit an artery and a vein, and into each incision inserted tubes leading from the mechanical heart.

The electric motor was started and a pump on the device drew dark blood from the vein. The blood passed through the artificial lungs of the machine, where impurities were removed and the blood charged with oxygen. Another pump then forced the purified blood into the artery. Slowly, as the body cells absorbed the life-giving oxygen, the man opened his eyes and looked at the doctors about him, as a man in a stupor might do. But after two minutes the spark of life flickered out.

The heart machine, right, was invented by Dr. Brukhanenko, of Moscow. It was used as is shown in the Chinese print, to act as a heart when connected with a dead dog's head

Just a few days ago, a woman lay on the operating table at University Hospital in Baltimore. An attendant suddenly cried out excitedly that he could not feel any pulse in the patient. The surgeon, through an incision already made, thrust his hand under the diaphragm and clasped the motionless heart in his fingers. Counting slowly, he alternately pressed and released the heart, keeping the blood flowing through the woman's body. At last the heart began to beat of its own accord. The operation was completed and the woman recovered.

In Geneva, Switzerland, a persistent scientist experiments with bodies of persons apparently drowned or shocked to death by electricity. There is no pulse in the bodies or any other sign of life. The experimenter massages the heart lightly for ten or fifteen minutes. In many cases the stilled heart has responded and the man has recovered. A French doctor, although he has not restored life, has made an experiment as interesting. Taking an infant that had been dead for twenty-four hours, he has massaged the heart and caused it to beat of its own power. In Japan, another physician has done the same with the dead heart of a young boy.

Attacking the problem from a different angle, Professor Wilder D. Bancroft, of Cornell, is seeking to postpone death. A simple chemical, known as sodium rhodanate, would, he declares, increase a man's life at least two years. Taken after a man reaches forty-five, the chemical would prevent hardening of nerve and brain tissue and increase resistance to disease.

Still, the actual restoration of life in a man known positively to be dead has not yet been accomplished. Dr. Cornish, elated at the sensational success of his experiments with dogs, wants to make the attempt. He is now seeking permission to experiment with a criminal executed by poison gas. Given the body after physicians had declared the man to be dead, he would strap the body to a teeterboard and attach electrical heating pads to the limbs. Next a chemical known as methylene blue would be injected into the veins to neutralize the poisonous fumes that had caused death. Pure oxygen would then be pumped into the lungs through a mask and the teeterboard rocked slowly to keep the blood in circulation.

As a last step, the life-giving fluid would be injected into a large vein. Consisting mainly of human blood, this would contain adrenalin, or epinephrine as it is known in the chemical list of drugs. This substance, as if by magic, causes the heart to contract sharply, restoring a normal pulse even after the heart on its own account has ceased to beat. Following this injection, Dr. Cornish believes firmly that the dead man would live. He does not agree with other scientists that the brain of the man so revived would be hopelessly damaged.

Brain and nerve tissue, unlike less specialized cells, break down rapidly. An American authority holds that brain cells begin to fail the moment the heart stops, or even before if the pulse should be greatly enfeebled. A Frenchman sets the time at twenty minutes after death. Many scientists accordingly hold that a man restored to life might be blind, wholly or partially paralyzed or even feeble-minded.

Dr. Cornish, in his experiments with dogs, has sought to prove this fear unfounded. Lazarus V, the terrier he asphyx-

This is an enlarged photomicrograph section of human cells that are still alive and are throwing out connective tissue though they have been separated from the parent body for more than a whole year

iated and then brought back to life after four minutes, has apparently recovered normal intelligence. It was suggested that this restored brain power is merely another example of an animal's ability to act purely on its instincts. Dogs with the gray matter removed from the brain have been taught to respond to certain signals. Lazarus V, however, has gone far beyond this basic evidence of intelligence. Since beginning his second life, he has learned to bark and eat and to stand alone. He has even taken a few wobbly steps.

The groundwork for the methods used by Dr. Cornish were laid unconsciously by a London physician in 1855. The physician, Dr Thomas Addison, of King's Hospital was interested only in finding a cure for a strange malady. The ailment, afterwards known as Addison's disease, affected the heart, gave a copperish tint to the skin and left the pulse feeble and irregular. Addison discovered that it was caused by failure of the suprarenal gland, a ductless capsule about two inches long above the kidney. The secretions of this then little-known gland had a mysterious effect on the heart and blood vessels.

Research men soon succeeded in making an extract of the gland. This extract, it was discovered, had also the remarkable power to prevent bleeding and for years it was used for this purpose in surgery. But the extract was unstable, when exposed to air it quickly lost its power. Scientists in many parts of the world struggled to isolate the active principle of the gland, as chemists in later years extracted the vitamins from the fats and other matter in cod liver oil.

Then in 1900 a Japanese scientist, working in America, succeeded almost overnight. Mere chance had led him to undertake the work. He had come to America ten years earlier to introduce his own method of making whiskey. Retained by a distillery at Peoria, Illinois, he aroused the jealousy of other distillers and malt makers and one night his distillery was burned to the ground. Discouraged and ill, he went to New York and interested a medicine manufacturer in the discovery the distillers had spurned. This manufacturer, like others at the time, was keenly interested in the problem of suprarenal gland extract. He gave the job of isolating the active principle to the Japanese.

Setting up a laboratory in the basement of his New York apartment, the latter went resolutely to work and within a few months produced a powder of fine, white crystals that contained the active properties of the gland. It was slightly bitter to the taste and would instantly bleach mucous membranes. Its discoverer, Dr Jokichi Takamine, named it adrenalin. Still, for all the importance of his discovery, he died in 1922 without knowing that adrenalin, sometimes under other names would one day be used to perform seeming miracles. Not until 1923 in a St. Louis hospital were its amazing possibilities realized.

A white-haired old man walked into the hospital critically ill and was operated on at once. Two weeks later a second operation was found necessary. After the anaesthetic had been administered, the old man ceased to breathe and the supersensitive electrocardiograph showed no heart action. Artificial respiration was applied without effect. Surgeons then decided upon what seemed a desperate course. They prepared a solution con- (Continued on page 108)

REPRODUCING ANCIENT MIRACLES IN THE LABORATORY

Here Dr. Cornish is seen working to restore a dead dog to life. The animal, dead four minutes, was revived so successfully that it was restored to full health and vigor in a very few days

Clever Detectives Solve

Remarkable

A Bureau of Forestry expert examining a piece of wood for comparison with the ladder used in the Lindbergh kidnaping

By **K. Y. SANBORN**

AN IMPORTANT witness against Bruno Richard Hauptmann in his trial for the kidnaping of the Lindbergh baby is—a piece of wood! Experts of the U. S. Forest Products Laboratory, in Madison, Wis., believe that they have traced the material used in the kidnaper's ladder to a lumber yard in the Bronx, New York City, where the German carpenter was once employed.

Early in the investigation of the kidnaping Col. H. Norman Schwartzkopf, superintendent of the New Jersey State Police, asked the help of this special division of the Forest Service to develop any clues that might be revealed by the ladder. An intensive technical examination by Arthur Koehler, senior wood technologist at the Laboratory, revealed not only the kind of wood used in the ladder, but also certain distinctive and peculiar markings.

On the basis of his conclusions as to the causes of these markings, Koehler examined lumber samples from mills scattered from New Jersey to Alabama. The persistence with which he worked and the possible importance of his findings, have attracted nation-wide attention to the seeming miracles that can be performed through wood identification.

Wood is a telltale. Let criminals beware of it. It can change its inner structure no more than a leopard can change its spots. Under a high-powered microscope, and sometimes with the use of polarized light, which brings out differences that cannot be seen in ordinary light, wood which has even been ground into sawdust, petrified, or burned into charcoal has been identified by experts at the Forest Products Laboratory.

Before the Lindbergh kidnaping investigation, Koehler's work in wood identification figured in another sensational case. This was in the so-called "Yule-bomb" murder mystery, which occurred in Wood County, Wisconsin. In this case a bomb had been mailed to James A. Chapman, a member of the Wood County Drainage Commission, which had been having serious disputes over its right to order the drainage of certain farm lands.

At three o'clock on an afternoon two days after Christmas, Chapman's grandson brought into the living room of the Chapman home a package that had arrived in the rural mail delivery. Interested in what appeared to be a belated Christmas gift, Mrs. Chapman bent over to watch her husband unwrap the package. As he untied the third of three strings which held it, there was a sudden explosion, shattering his left hand and severely injuring his left leg. Flying pieces from the bomb struck Mrs. Chapman about the head and body, resulting in her death the following day.

Suspicion centered on a farmer named Magnuson, who had had violent arguments with Chapman concerning the right of the Drainage Commission to drain a portion of his farm. The case came to trial in the Circuit Court the following March, before a jury of eight men and four women.

Exhibit A in the case was a piece of wood about five inches long and one and one fourth inches square. A reconstruction of the bomb had established that it had consisted of a piece of gas pipe inserted in a block of white elm. Charged with picric acid, the bomb had a metal trigger, or release device, similar to a timing device on a gas engine on the Magnuson place.

Wood shavings found in Magnuson's workshop had been exhibited at a preliminary hearing held shortly after Mrs. Chapman's death. At this time Magnuson's lawyer had termed a "vaudeville act" the attempt to use these wood shavings to link Magnuson with the crime, particularly since the shavings were of oak while the wood used in the bomb was white elm.

Federal inspectors made a second investigation of Magnuson's workshop. At first the appearance of the shop had borne out Magnuson's claim that he had no white elm in his possession, but shavings and sawdust of that wood, which had apparently escaped his notice, were found behind a leg of his work bench.

When the case came to trial, one of the star witnesses was Arthur Koehler, who testified that three scraps had been identified at the Forest Products Laboratory and that they had been proved to be of the telltale white elm. Members of the jury declared, after they had found Magnuson guilty of murder in the first degree, that the combined testimony of Koehler and of experts in metallography sent from the University of Wisconsin to help identify other parts of the bomb, played a leading part in convincing them of Magnuson's guilt.

Innocence as well as guilt has been

A braided whip from the lacebark tree, one of the odd specimens identified at the Laboratory

Secrets Hidden *in* Wood

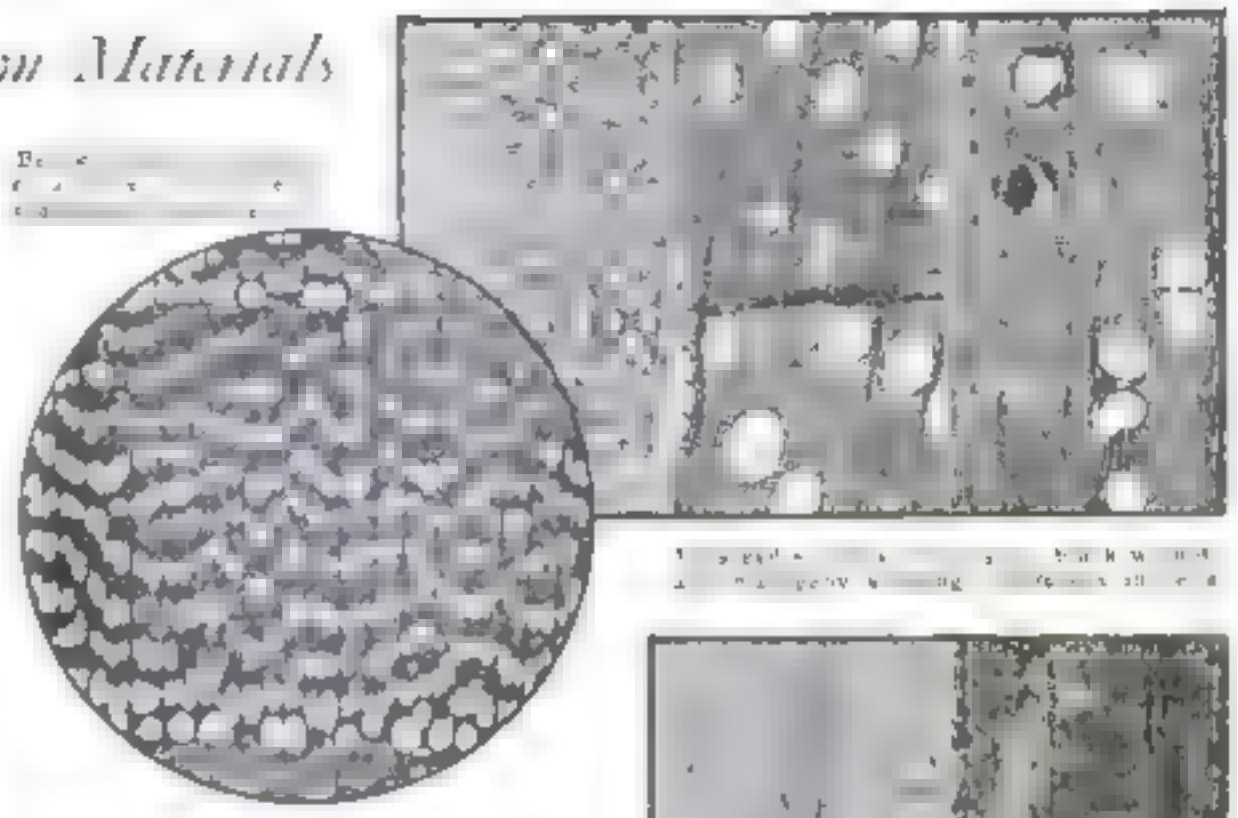
Tests Identify Unknown Materials

established through wood identifications made by Koehler and his associates. During the celebration of a football victory at the University of Wisconsin, quantities of alcohol had been stolen from a storeroom. The thief had gained entrance to the storeroom by boring a hole near the lock with an auger. A suspect was cleared when wood fragments found in his auger were examined by Koehler and proved not to have come from the door.

The Lindbergh case is not the first "ladder case" with which Koehler has been connected. Two painters of Toledo, Ohio, were injured by the failure of a ladder rung which was supposed to support a ladder jack and one end of a scaffold. The injured men brought suit for damages against the company which had made the ladder. Koehler conducted a demonstration in court, explaining the characteristics of brash and sound material, and showing the possibity of injury to strength of rungs through rough handling. After listening to his testimony, the court decided that the ladder company had not been at fault.

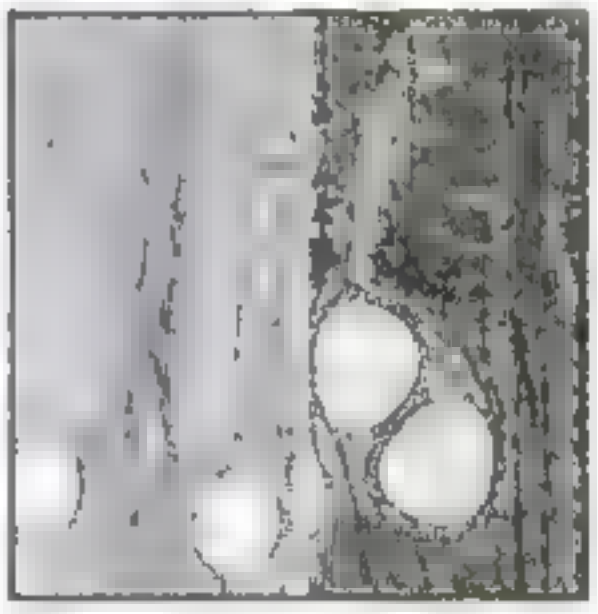
THERE is romance and adventure connected with the work of wood identification. Not long ago the services of the Laboratory were sought by a salvage company which was trying to gain access to a ship sunk 134 years ago off the coast of Delaware. In diving operations two ships had been discovered in close proximity to each other, and in order to save the expense and danger of entering both ships, the divers took specimens of wood from each ship. These were sent to the Forest Products Laboratory, and the designation of one specimen as Jamaica dogwood and the other as a species of juniper helped the salvagers determine, by a search of marine records, which was the supposed treasure ship.

The mystery which still conceals some of the past can be partly lifted by means of wood identification. When Italian



engineers, at Premier Mussolini's instigation, drained a part of Lake Nemi and uncovered the galley that nearly 2,000 years ago had been a floating palace of pleasure for the Roman Emperor, [illegible] one of the first things that was [illegible] the identification of the wood [illegible] nous parts of the ship.

The predominant wood of Aeppo pine, owing to its high resin content was in a perfect state of preservation, despite having been immersed in water for hundreds of years. Even today in the hills and low mountains of Umbria, *Pinus halepensis* is a profuse variety. It is probable that this was the timber most readily accessible 2,000 years ago. Judging from the remarkable dimensions of the lumber from which the great beams of the keel and the large



Photomicrographs of red oak and white oak, woods hard to distinguish if not magnified

boards of the belting were cut, we can believe that very beautiful forests must have existed there at that time.

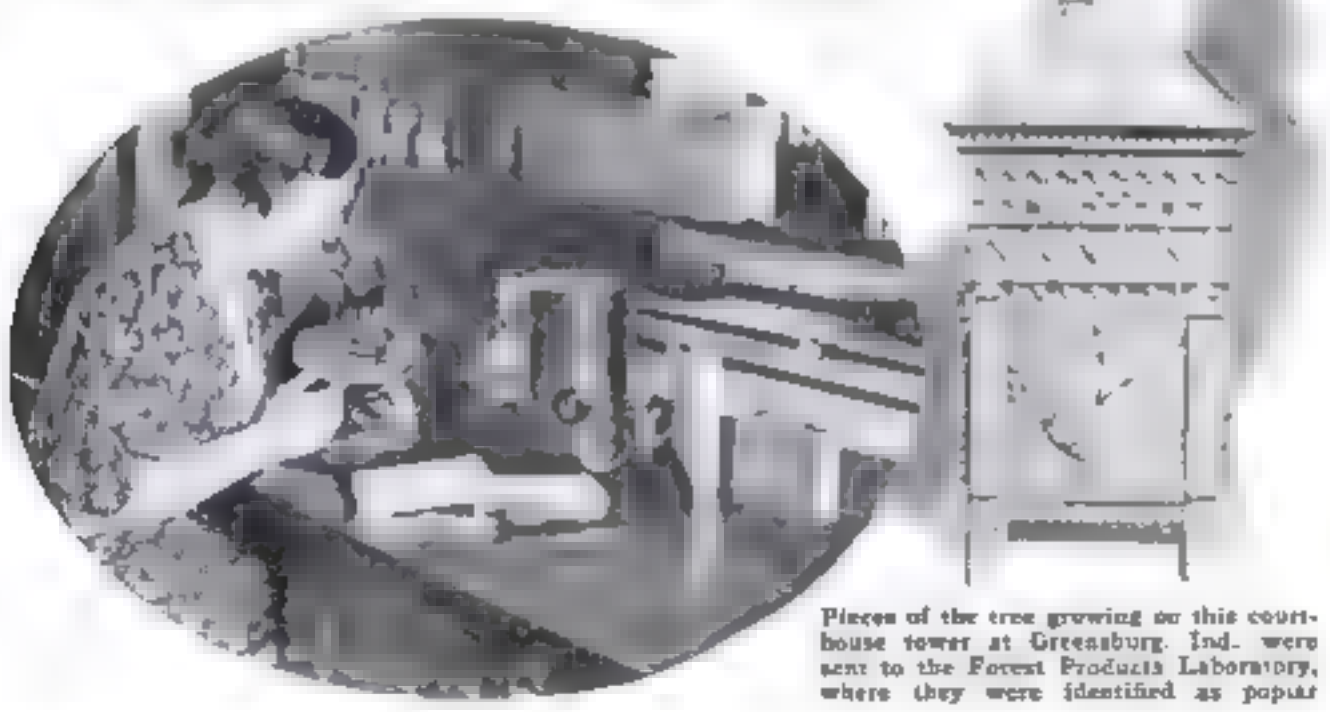
In order to determine the history of a treeless prairie valley in the southern part of Florida, wood specimens were submitted to the Forest Products Laboratory for identification. In ditching operations in the Kissimee Valley a number of tree stumps had been unearthed, indicating that at one time these prairies were forested. Two of the specimens were of yellow pine, while another had the characteristics of wax myrtle, of which two species grow in the South at the present time.

A stump found where an Alaskan glacier had receded was examined by Miss Gertrude Griffin, microscopist in Koehler's section on wood identification, and found to be spruce. Miss Griffin has noted, in her varied experience in identifying wood, that many ancient or fossilized specimens coming from widely separated parts of the world, are spruce.

Koehler, speaking of the requests for identification of old woods, makes his own interesting comment.

"Sometimes we receive partly decayed wood, such as that from old *(Continued on page 114)*

Miss Gertrude Griffin, assistant to Koehler, is shown below at her desk in U. S. Forest Products Laboratory



Pieces of the tree growing on this courthouse tower at Greensburg, Ind., were sent to the Forest Products Laboratory, where they were identified as poplar

ODD AIRCRAFT AIDS TRAFFIC STUDY

When police of Paris, France, recently undertook to study traffic conditions, they hovered over the city in the hybrid aircraft shown in the picture above. The lifting part of the machine is a non-rigid army observation blimp. This has been turned into a dirigible by adding a modified airplane which contains a motor and controls, and has skids instead of landing wheels. The wings are pivoted and, when they are inclined, the craft is able to climb or descend at the will of the operators.

ELECTRIC SOLES KEEP MOTORIST'S FEET WARM

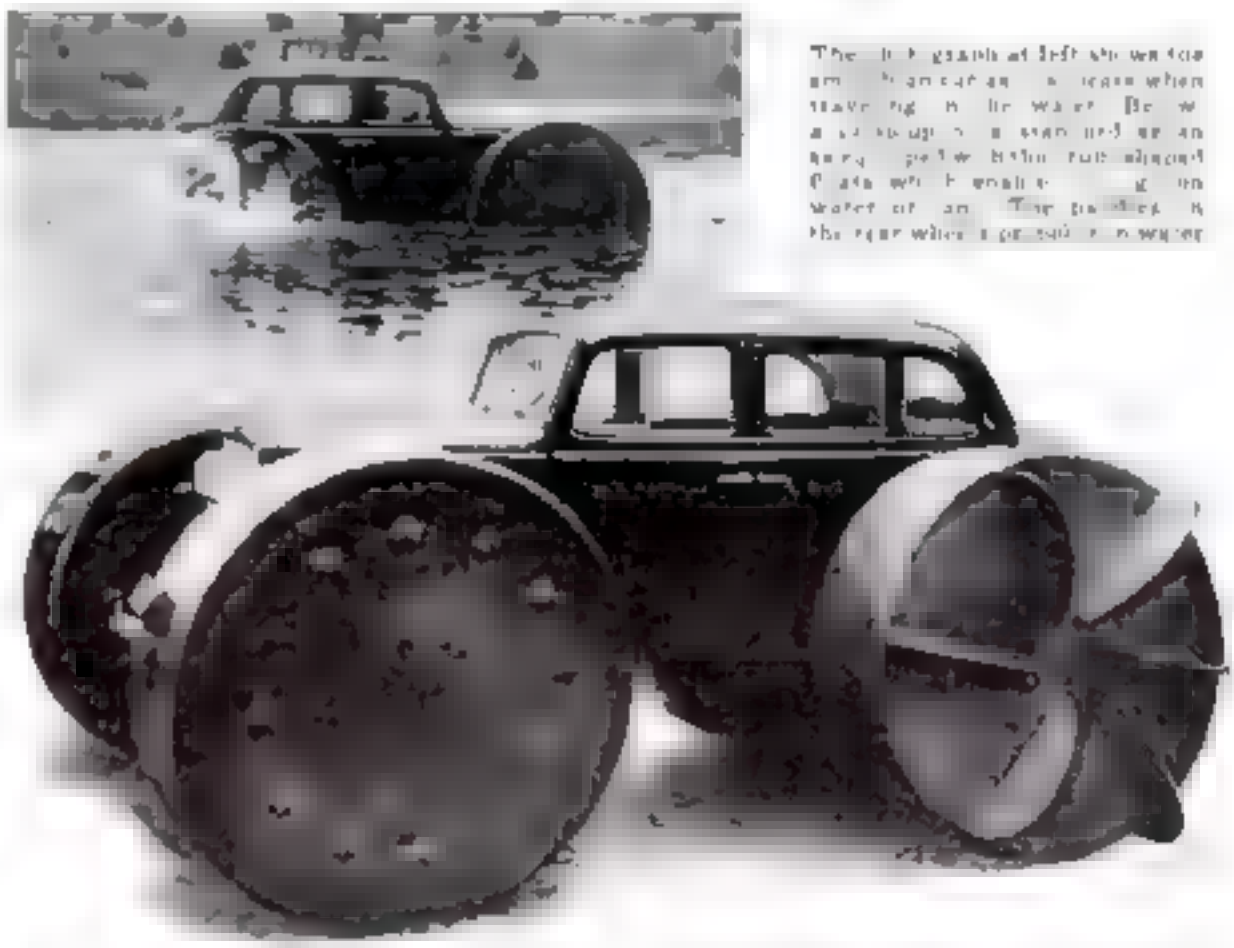
Electrically heated soles, which may be worn inside any pair of shoes, are a recent German invention to end the discomfort of chilly feet during a winter drive. Electric current from the car's battery is provided through a plug-and-socket connection on the instrument panel, from which cables lead to the pads. When the driver wishes to leave his car, he can detach the cables from the soles.

YEAR-ROUND DOG COUCH

A dog lover may provide all-the-year-round sleeping comfort for his pet, with the introduction of a combination couch that must appear luxurious to canine eyes. Built like a bed in miniature it offers a warm mattress for a winter-day nap, together with an overhanging canopy as a shield from drafts. In summer this canopy serves as a hammock where the dog may lie to keep cool, as shown above

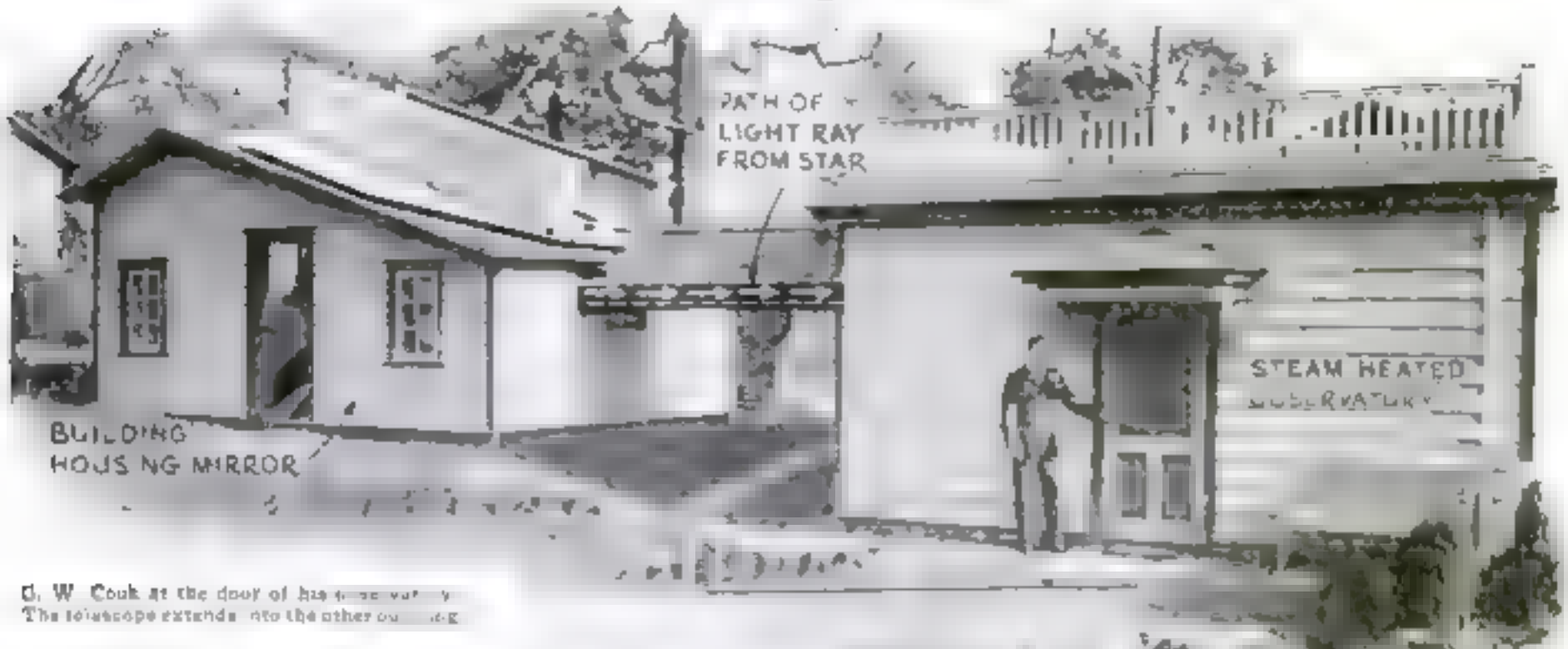
Combination dog couch, as it is used in winter

FLOATS TURN CAR INTO AN AMPHIBIAN



By removing the wheels of a standard sedan and substituting buoyant, drum-shaped pontoons, a German inventor has rendered the machine capable of traveling with equal ease on land or water. Tests show that the amphibian car rides sufficiently high, when afloat, to prevent even a drop of water from entering the body or engine compartment. Six paddles on each of the rear drums, which are rotated by the power of the car's motor propel the car in the water. On land, it rides on the flat rims, resembling a road roller in miniature. Smaller floats than the ones used on this experimental machine are being perfected by the inventor for use by tourists and campers, and will be readily interchangeable with conventional pneumatic wheels.

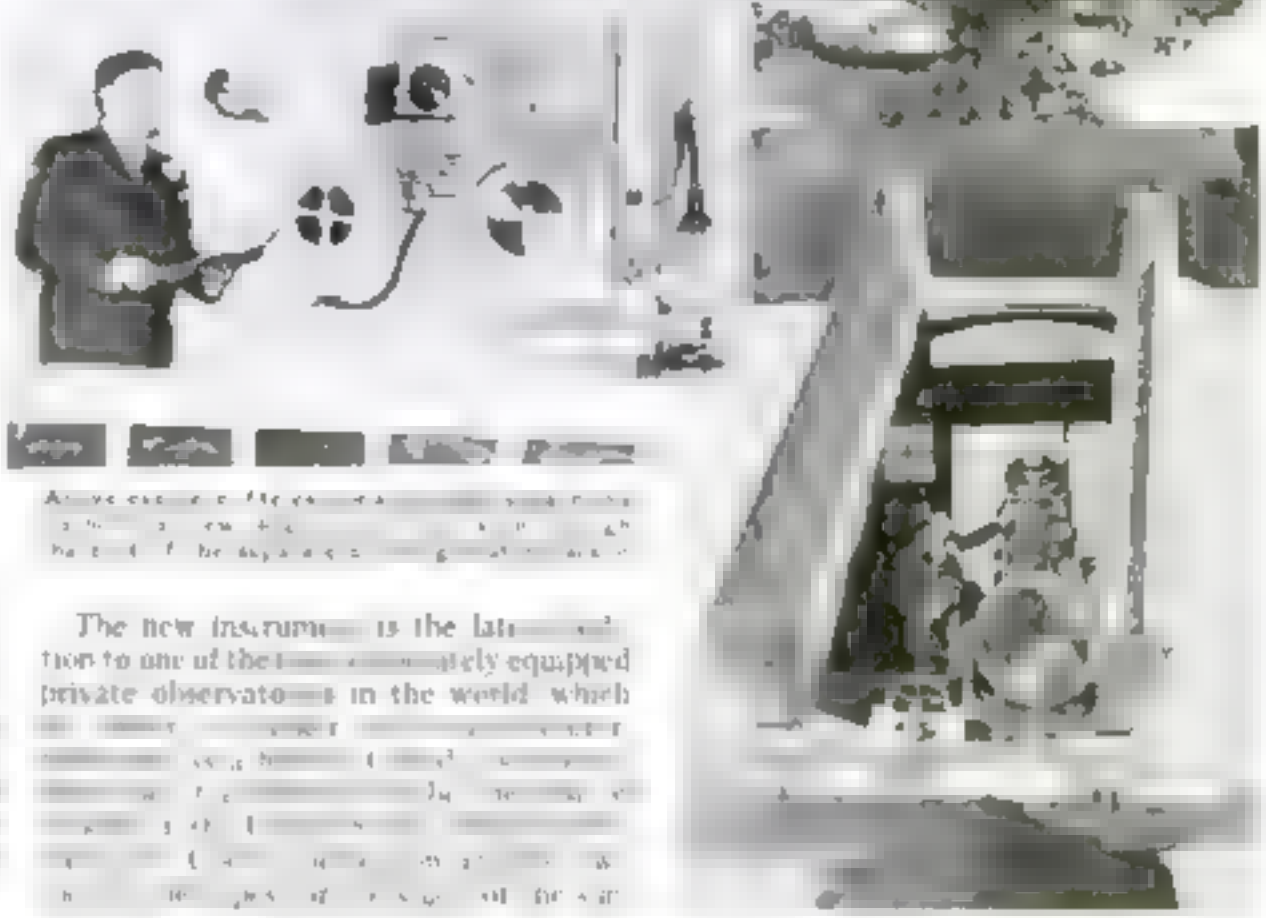
Horizontal Telescope Scans the Stars



C. W. Cook at the door of his observatory. The telescope extends into the other building

WHEN he wishes to look at the stars at night, C. W. Cook walks from his residence in Wynnewood, Pa., to his comfortable steam heated observatory. He pays no attention to the weather. Instead, he simply steps to the wall of the room and gazes into the eyepiece of a fifteen inch refracting telescope that extends horizontally to an adjacent building. There a twenty-five-inch mirror which it took, operates by remote electrical control, swings his field of vision to any desired direction.

Once the mirror is correctly adjusted, an electric motor automatically turns it at a pace that just compensates for the rotation of the earth, keeping the telescope trained on any particular star. While the telescope is in use a pair of folding doors in the roof of the building housing the mirror are kept open. [illegible] opening for the mirror.



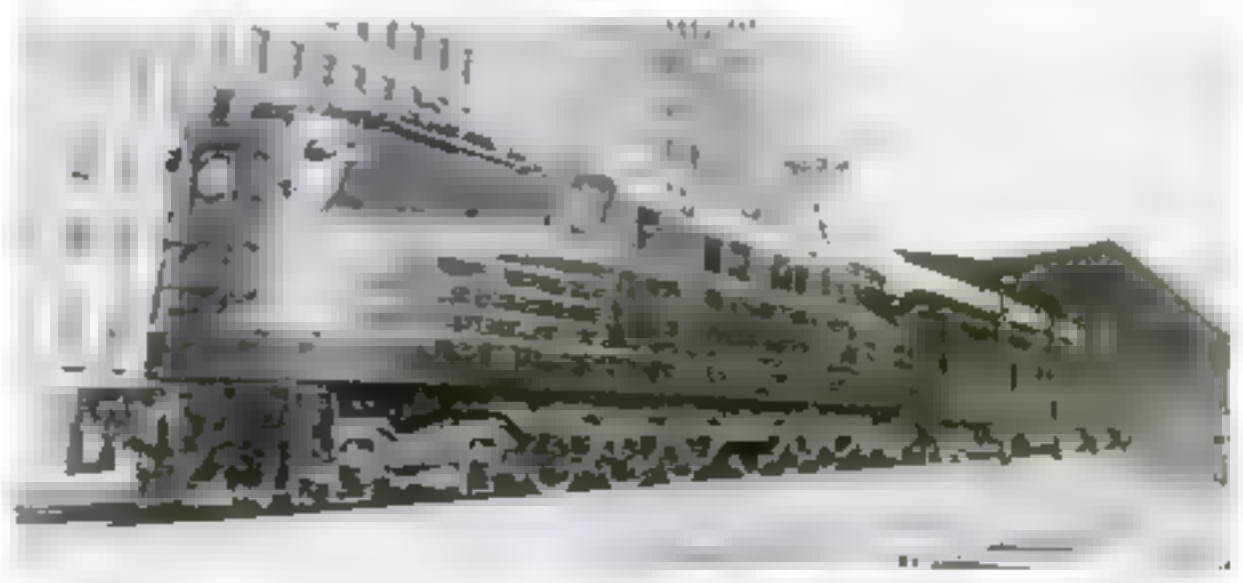
[illegible] The new instrument is the latest addition to one of the most completely equipped private observatories in the world, which [illegible]

MAKES SAW FILING EASY

DULL saws are sharpened accurately and with a minimum of fatigue by the new saw filer shown above, whose pistol grip, holding a standard triangular file, is shaped especially to fit the hand. By keeping an adjustable guide rod parallel with the saw blade, all the teeth may be filed alike and at the proper angle—straight across for ripsaws, and at various angles for crosscut saws.

ELECTRIC ENGINES GO STREAMLINE

FIFTY-SEVEN streamlined locomotives recently ordered by the Pennsylvania Railroad for its projected high-speed passenger service between New York and Washington, D. C., will be the most powerful ever to haul passenger trains. The 4620-horsepower engines will be capable of a regular operating speed of ninety miles an hour. Their design places the motorman's cab near the center, with unobstructed view

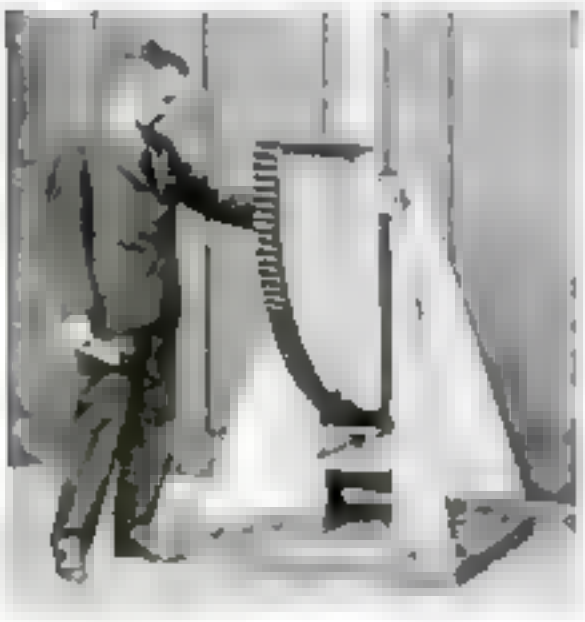


Streamlined electric locomotive of the type to be put in service by the Pennsylvania Railroad

MIDGET CAR RUNS ON TWO WHEELS

Though it has four wheels, a midget car exhibited in England runs on only two. The tiny machine is balanced like a motorcycle, but is guided by a steering wheel instead of handlebars. Two small auxiliary wheels keep the car upright in turning or stopping. The narrow body, equipped with a windshield, seats two persons

POLE COMES DOWN FOR PAINTING



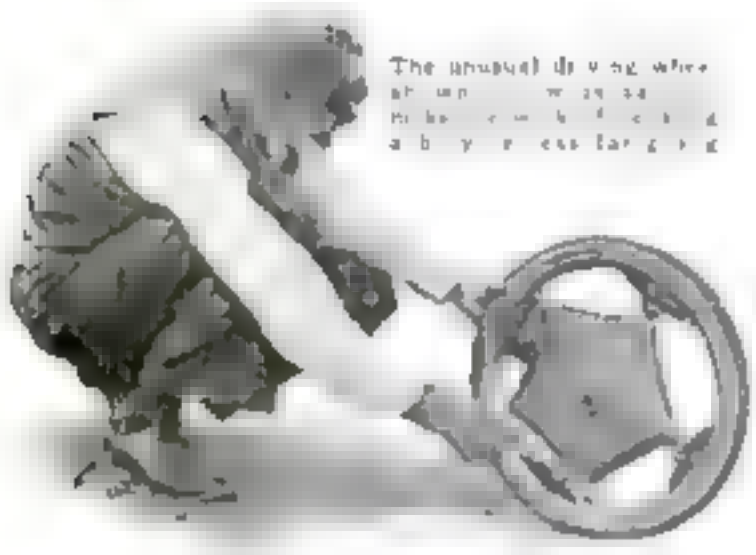
When a flag pole of recent invention needs painting, no steeplejack need climb it. A crank, operating a worm gear at its base, lowers the pole to a horizontal position, in which a better and speedier job of painting may be done. The photograph shows the invention applied to a forty-two-foot steel flag pole, in the vertical position.

HAMS EXPLORE ULTRA-SHORT WAVES

To explore the little-known region of ultra-short waves, with practical television as their goal, radio amateurs have set up a five-meter station in New York City with its special telescopic beam antenna, shown above, atop a hotel roof. Using only fifteen watts of power, the station has established two-way voice communication with nearly every town within forty miles. The tests prove that such transmission is possible over considerable distances.

FOUNTAIN BRUSH FOR STENCILING

Handy for stenciling, a new fountain brush contains a generous supply of ink in its handle. Even flow of ink to the bristles is assured by pressing occasionally upon a button that operates a diaphragm pump, as shown in the illustration. This forces the diaphragm inward and keeps sufficient ink in the bristles for continuous stenciling



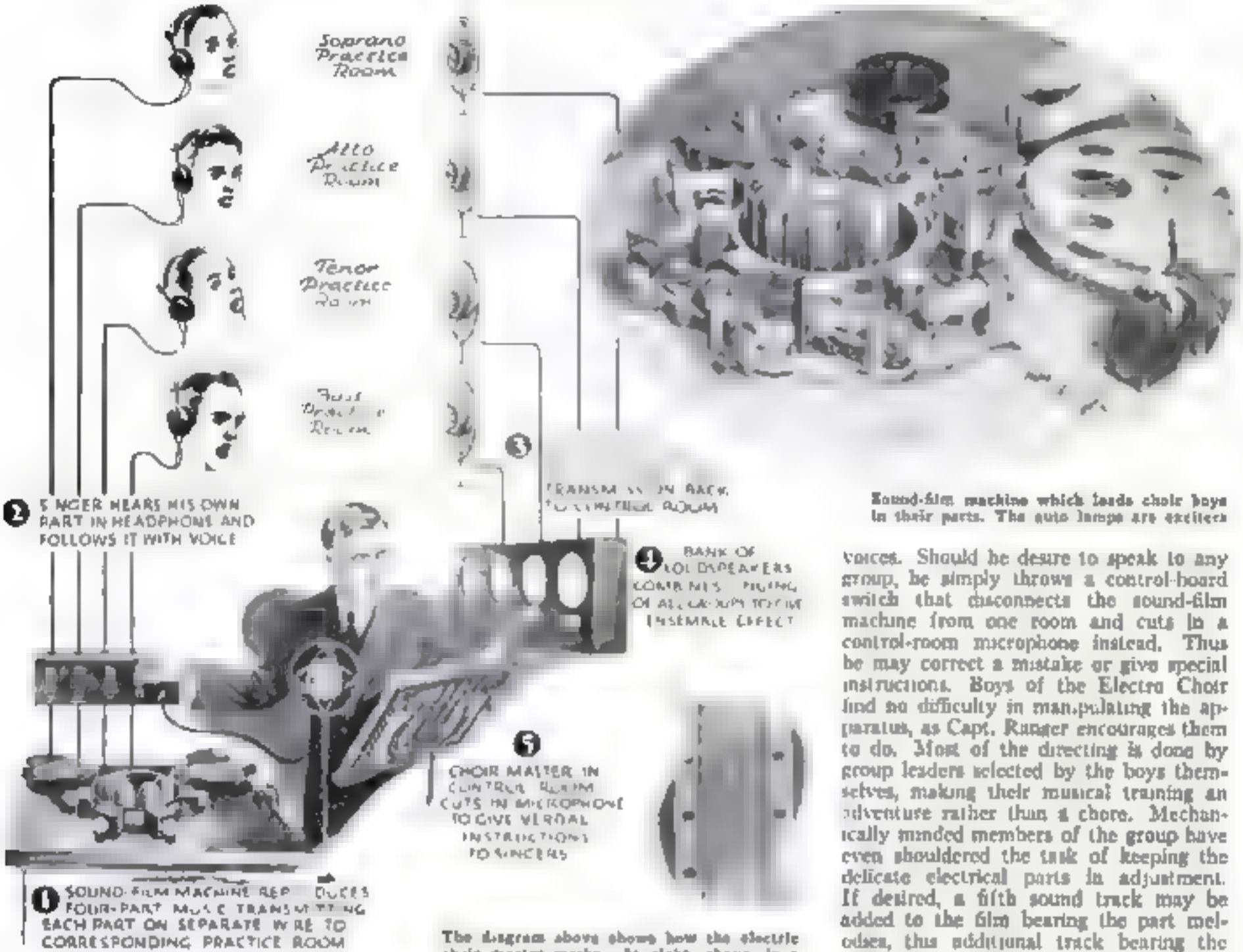
NOVEL GEAR DRIVES BICYCLE

An eccentric, star-shaped disk serves as both hub and spokes of a novel driving wheel for bicycles, devised by a Long Beach, Calif., inventor. The five-sided disk transmits power to the rim through four rollers upon which it is free to turn in either direction, the weight of the rider locking the inner and outer wheels.

ESKIMO BOY IS SHIP MODEL FAN

Even within the shadow of the Arctic Circle, model makers are to be found. The photograph at the right shows an Eskimo boy of the Ungava district of northern Canada trying out his miniature sailboat, with a flour bag serving as a sail. The model is a faithful reproduction of the oomiak, a large type of Eskimo craft with wooden frame and hull of sealskins, which accommodates ten or more persons. In favorable wind a square sail is used, otherwise the craft are propelled by broad paddles.

Electric Robot Trains Singers



The diagram above shows how the electric choir master works. At right, above, is a strip of the sound film used in the machine

Sound-film machine which leads choir boys in their parts. The auto lamps are exciters

AN ELECTRIC singing master that quickly teaches boys to blend their voices has been perfected by Capt. Richard H. Ranger, of Newark, N. J., as the latest of his inventions in the field of electrical music. Hitherto the instructor of a glee club or choir has had to train the bass, tenor, alto and soprano groups one at a time, later bringing them all together. The new apparatus, however, enables all the singers to practice at once. It has already been used successfully to train a group of sixty that calls itself the "Electra Choir." How it works is shown in the accompanying diagram. The heart of the apparatus is a sound-film machine especially designed to lead the singers in their parts, which is set up in a "control room" of the clubhouse where the singers practice. The machine resembles the reproducers used in sound movies, with one important difference. Music recorded on the film is split up into four separate sound tracks corresponding to the four singing groups' parts. Each part is picked up by a separate photo-electric cell and transmitted electrically to one of four separate practice rooms in the clubhouse, where the singers of that particular group hear their part through a loudspeaker or through individual headphones. A microphone in the practice room picks up their singing and carries it back to one of a bank of loudspeakers in the control room. Here the leader of the choir listens to the blended voices. Should he desire to speak to any group, he simply throws a control-board switch that disconnects the sound-film machine from one room and cuts in a control-room microphone instead. Thus he may correct a mistake or give special instructions. Boys of the Electra Choir find no difficulty in manipulating the apparatus, as Capt. Ranger encourages them to do. Most of the directing is done by group leaders selected by the boys themselves, making their musical training an adventure rather than a chore. Mechanically minded members of the group have even shouldered the task of keeping the delicate electrical parts in adjustment. If desired, a fifth sound track may be added to the film bearing the part melodies, thus additional track bearing the musical accompaniment with which the boys will eventually sing in public. This sound record is used for the final rehearsals of the united groups, after they have perfected their own parts separately. Certain refinements have been made in the system as the result of suggestions from the boys themselves.

A group of boys in one of the practice rooms, singing with the aid of headphones. The loudspeaker beside the piano provides an alternate means of bringing music or instructions

American "Devil's Island"

HOLDS TOUGHEST PRISONERS

On a Bleak Rock in San Francisco Bay, Uncle Sam Has Reared the World's Most Formidable Prison

By ANDREW R. BOONE

TOOL steel that no file can scratch, locks that can be opened electrically and mechanically only by two men from widely separated posts forty veteran guards hand-picked from other federal prisons, armed with automatic pistols, rifles, and machine guns tear gas, electric instruments that reveal the presence of hidden pistols or knives on the persons of prisoners or visitors barbed-wire entanglements, one and one half miles of water whose current defies all but the strongest swimmer, patrol boats of penitentiary and coast guard; prison radio that can summon 200 police cars to the shores of San Francisco Bay in five minutes.

Thus, through science and skilled officers, does Uncle Sam guard 211 of the world's worst felons on twelve-acre Alcatraz Island, a bleak rock in San Francisco Bay which for nearly a century has served as a prison. Recently the old cell block has been reconstructed internally, with the latest types of scientific devices ready to quell instantly any uprising or call upon law-enforcement agencies the length of the Pacific coast for aid should a prisoner escape. Today Alcatraz is the most formidable rock-bound prison fortress the world has ever known, far more securely guarded than the famous French Devil's Island.

Uncle Sam holds little hope of reforming the crooks he has incarcerated there. He sent them to Alcatraz for three reasons to make sure they will not intrude themselves among law-abiding citizens before they have paid their penalties to society, to save them from the possible wrath of their enemies, and to make it impossible for them to spread their evil influence among less hardened criminals.

For some years the Department of Justice has practiced segregation of prisoners. Heretofore it has taken the form of separating younger prisoners and first-termers from two- and three-time losers, hoping thus to reform many of them. Now Uncle Sam has moved to the other end of the line and isolated the toughest. From now on the Department of Justice will strive to keep them by themselves in what is considered the world's first escape-proof prison.

"Segregation has had a large part in federal programs in reforming offenders against society," Warden James A. Johnston told me. "Camps, farms—prisons by whatever name—with liberties within each institution serve to help rehabilitate less hardened convicts. At Alcatraz we reach the form of prison where maximum security with limited privileges is sought Generally, these men have had opportunities in other prisons to reclaim themselves; but now their records make it necessary for the government to lay emphasis on their security."

For that reason the Department of Justice hit upon the idea of reconstructing Alcatraz and using it as a prison for these

A guard at Alcatraz Island watches the movements of prisoners from one of the four towers. Powerful floodlights, radio equipment, and speedy patrol boats assist in preventing escapes and deliveries

desperate criminals. The island lends itself admirably to that plan. It is within reach of near-by cities, but is not readily accessible. It enables prison authorities to take advantage of natural surroundings.

Elaborate precautions have been taken to guarantee security. The cells are built of tool-proof steel, with window guards of the same metal. Doors are locked automatically by remote levers. One door or all doors by units of fifteen may be opened simultaneously. When prisoners march from one building to another two men are required to open each door. A gate keeper and an armorer, the former swinging a lever and the latter pushing a button to close an electrical circuit so the key can be turned in the lock, must work together. They see each other through a bullet-proof glass window and talk with each other through a microphonic unit, yet it is impossible for prisoners to reach both of them at once and thus force their way from the cell block.

No weapon other than those comprising the carefully counted and double-checked arms of the guards, is permitted within the prison. All visitors, including state and federal officers, are searched by a hidden electrical detector as they enter the prison. At several points where prisoners or visitors must walk in single file two detectors are hidden from view. Any gun [illegible] or even a nail in prisoners with the electrical circuit in the detectors. Near-by a buzzer buzzes and a light flashes, warning the guard that someone is carrying a weapon [illegible] so quickly the guard [illegible] take him aside for [illegible].

Many prison [illegible] room where prisoners [illegible] members, but also can provide themselves with weapons in the form of knives, forks, and spoons. Scattered around the ceiling of the Alcatraz cafeteria are several brightly-polished oval disks, not unlike automatic water sprinklers. Hidden behind their unimposing exteriors, however, are outlets for tear gas. Although guards mingle with the prisoners without fire-arms, a single turn of a wheel by a guard standing behind bullet-proof glass will flood the dining room with gas and leave the prisoners gasping for breath.

The prisoners are marched from cell blocks to the dining room in small groups. On entering each is given a knife and fork. At the close of the meal he checks in his utensils.

Although they are accorded few privileges, the prisoners are fed well. Here is a typical day's menu:

Breakfast—oatmeal and milk, fried bologna sausage, cottage fried potatoes, toast, oleomargarine, and coffee.

Dinner—bean soup, roast beef and gravy, stringless beans, mashed potatoes, bread, oleomargarine, and coffee.

Supper—pork and beans, corn bread, potato salad, apricots, bread, oleomargarine, and coffee.

Department of Justice officials, in planning the new Alcatraz, have attempted to outguess every move gangland might make. Any attempt to liberate a prisoner presumably would involve a boat. For that reason no craft, regardless of size or ownership, is permitted within 200 yards of the rocky shores. No visitor is permitted unless he presents a pass signed by the Attorney General of the United States. No prisoner may see a visitor during his first four months. (Continued on page 44)

Four guard towers like the one shown above, each reached from the prison wall by a high catwalk, enable guards to overlook all parts of the island

WORLD'S

RESTS ON SUNKEN

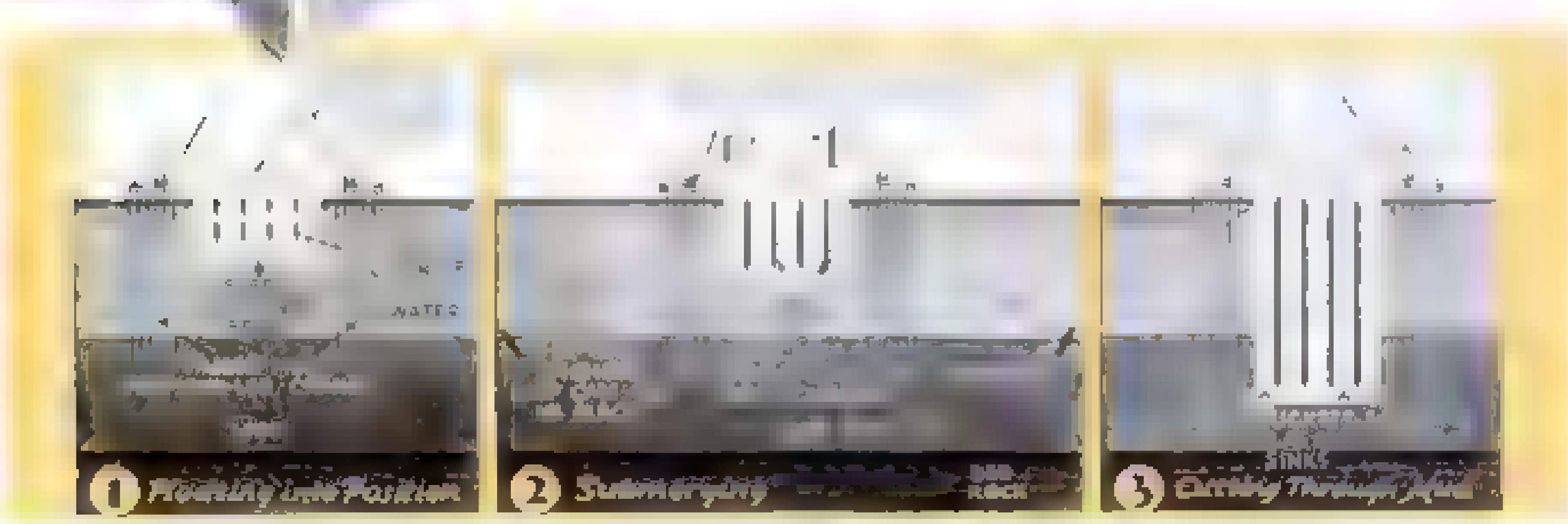
LONGER [illegible] a existence the [illegible] now being thrown over the [illegible] water between [illegible] entirely new method of [illegible]

Soaring 300 feet above the water, this tower goes down 180 feet to [illegible] rock below the mud bottom of San [illegible] Bay. Upon the ponderous mass of the central pier will fall the task of anchoring the abutting ends of the two [illegible] that comprise the span. [illegible] de to cover the two m[illegible] the island of Yerba Buena with one span. So two suspension bridges, anchored in mid-channel [illegible] central pier, are being [illegible]

The new-type caisson, sunk for the be[illegible] few feet of the bottom. These last few feet were of steel to form a cutting edge that would slice through the mud on the [illegible]

[illegible] afloat the caisson looked like a [illegible] beehives. The hives were steel domes welded to the tops of fifty [illegible] the caisson [illegible] ir and the caisson thus made buoyant was towed to a point in the west chan[illegible]

[illegible]



LARGEST BRIDGE

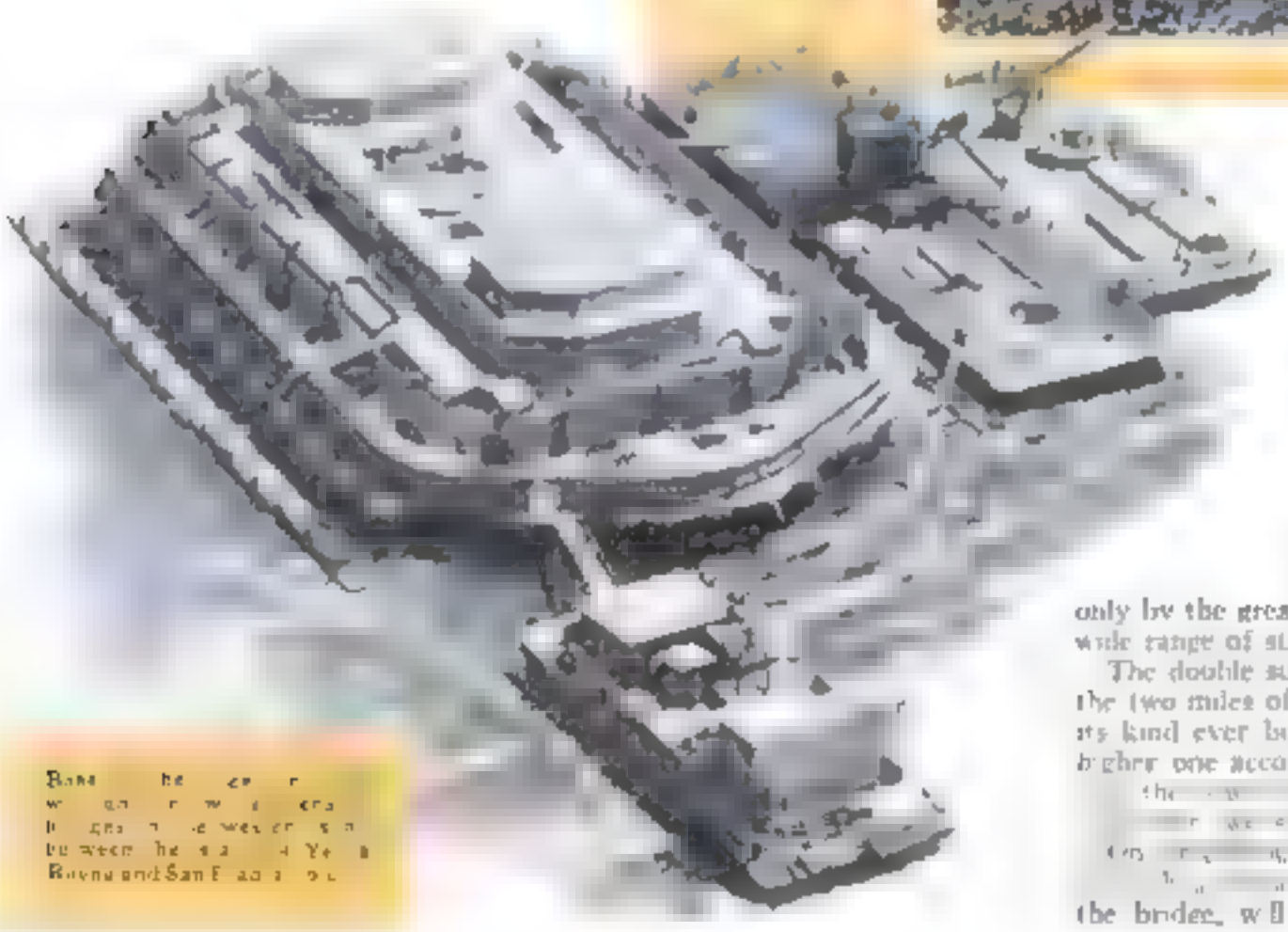
SKYSCRAPERS

the caisson and stiff-leg cranes set upon the timbers. A plank fender was then built around the caisson to protect it from chance collision with boats or debris.

Through jointed metal pipes, called "elephant trunks" by the workmen, concrete was poured around the tubes until the increased weight of the caisson almost submerged it. Workmen with acetylene torches then cut the domes from the tops of the tubes, removing only a few at a time so as not to disturb the caisson's buoyancy. Twenty-foot lengths were then added to each tube and the domes welded to the tops of the new lengths. At the same time, the timber sides of the caisson were built up. More concrete was poured in, offsetting the buoyancy of the added tube sections. Thus the caisson was sunk until it settled in the mud about eighty feet below the surface.

When the caisson, now a mass of concrete honeycombed by the fifty-five tubes, was firmly embedded in the mud, the pressure in the tubes was gradually released, care being taken that the structure remained perfectly plumb. The domes were then cut off and the tubes became shafts for the excavating buckets.

Lowered by cranes, these clam-shell buckets plunged down the tubes and grabbed up four cubic yards of mud at a time, raising it and dropping it into the adjacent bay. When harder bottom was encountered, high-pressure water hose was dropped into the tubes. The jets of water cut and softened the clay so that it could be grabbed easily by the buckets. As the mud and clay were excavated, the caisson settled deeper and finally came to rest on rock 180 feet down. The bottoms of the tubes at this time were sealed with [illegible] bright filled with water. The pier was ready for the [illegible] tion of the aboveswater shaft of concrete.



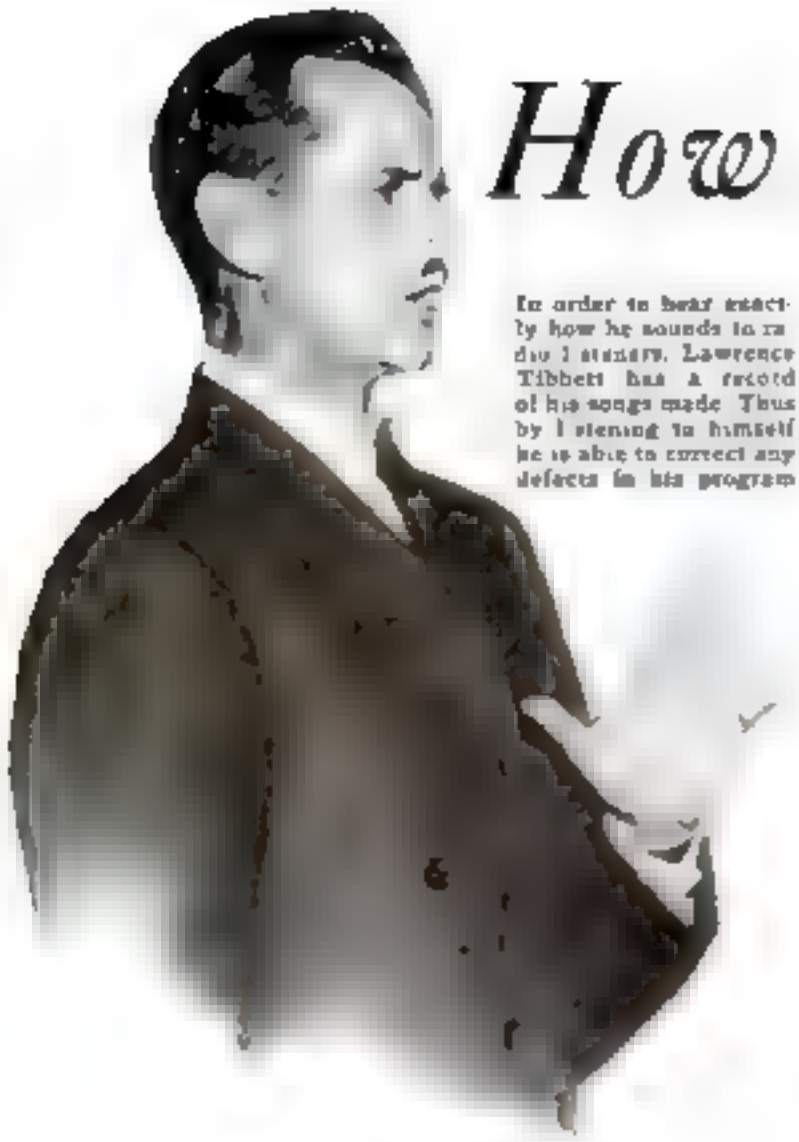
Base of the pier [illegible] will support the mammoth bridge between the San Francisco Bay and Yerba Buena and San Francisco [illegible]

© 1935 Toll Bridge Assn.

The pier is one of fifty-one that will support the mammoth bridge. Forty-four will be below water and one will rest on bed rock 218 feet below the surface. This unprecedented number of piers is required not only by the great length of the bridge but by the wide range of structural types represented.

The double suspension bridge, which will cross the two miles of west channel, is the only one of its kind ever built. It will have two decks, the higher one accommodating three [illegible] the [illegible] ding three truck lanes and [illegible] car tracks. [illegible] the bridge will have *(Continued on page 111)*

How Radio Stars *TO DEVELOP*



In order to hear exactly how he sounds to radio listeners, Lawrence Tibbett has a record of his songs made. Thus by listening to himself he is able to correct any defects in his program

By JOHN E. LODGE

BECAUSE you can't hear yourself talk, a new business is booming. Radio stars, like everyone else, hear the sound vibrations within their heads rather than the actual tones that reach the listeners. To hear themselves as others do and thus to improve their programs, nearly all top-notchers in recent months have been having their programs recorded on phonograph disks, so that they may play them over and study them critically later on. Eddie Cantor, Joe Cook, Burns and Allen, Paul Whiteman, Lawrence Tibbett and Rudy Vallee are but a few of the noted names of radio that listen in on their own broadcasts by this method.

In three eastern laboratories alone last year, tiny cutters of steel plowed more than 10,000 miles of grooves in spinning disks of wax, metal, and composition material to record in permanent form programs picked from the air.

At least a dozen studios now are in full swing. The oldest laboratory did more work in one recent month than in any previous year. Advertising agencies, hiring talent for the air, now select it almost exclusively from records. Politicians, lawyers, tourists, dramatists and business bureaus as well as radio stars, are taking advantage of the service. They add to the list of strange requests and queer demands that keep the record makers busy.

Not long ago, for example, an Eastern football team ordered records of all the broadcasts made during one of its own games. That night, members of the squad listened to the comments of the announcers, hearing what millions of fans had heard during the game a few hours before.

In another case, a music publisher with branch offices throughout the country introduced a new song. On the night of its first broadcast, he had records made to send to all the branch managers to show how the music should be played and how the words should be sung. Over the week-end, the studio turned out 100 duplicate records and had them ready for distribution on Monday morning.

Speed is an important item in the reproducing work. Many stars demand that the records be rushed to them as soon as the broadcast is over. Some send messengers to get them; others come to the recording laboratories to hear them, still others want them played over the telephone.

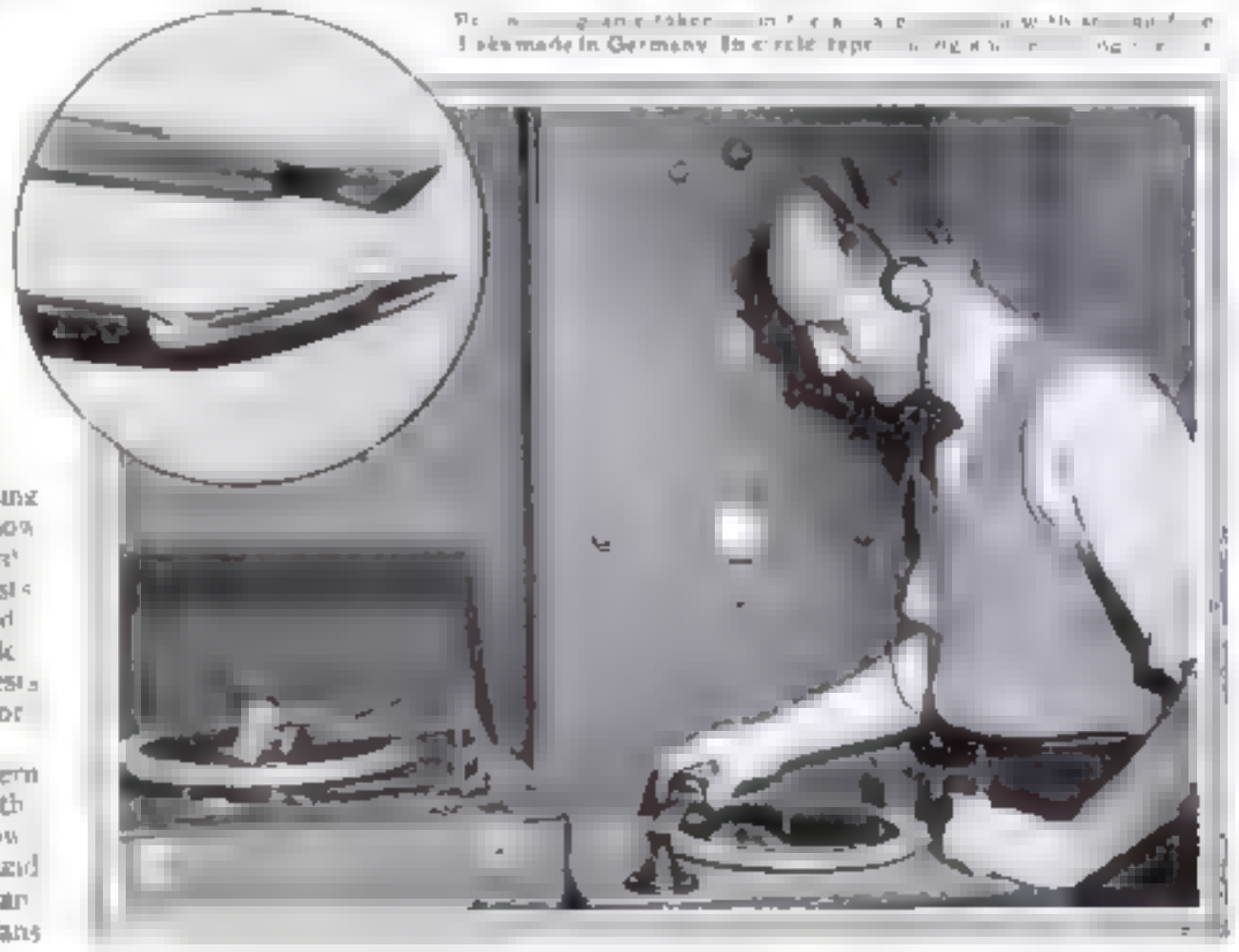
Lawrence Tibbett always has his records hurried to the broadcasting studio so he can take them home with him and play them before going to bed. He has a complete library of his broadcasts. Walter Winchell, the gossip columnist, has everything he says on the air recorded. But he doesn't do this just to hear the sound of his own voice. He keeps the records as evidence of what he really said in case he is misquoted or even sued for libel.

Burns and Allen want their records delivered at their apartment after every appearance on the air. They play them over and over to study the timing of their gags and to be sure they are not rushing their jokes too fast for the listeners to get them.

One hurry-up call the recording engineers are sure to get is from stars that broadcast twice on the same night. Frequently, a big hook-up goes on the air for Eastern and Central states at 8:30 P.M., Eastern Time, and then is repeated for Rocky Mountain and west coast states at 11:30 P.M. Every time Gladys Swarthout, Frank Chapman, and other stars appear on such a schedule they have the records sent to them immediately after the first broadcast so they can go over them to improve the second performance.

If you visited one of these recording studios, you would see huge drakoke machines with whirling turntables and a battery of dials. The programs are taken from the air by regular receiving sets, amplified, and recorded by the special apparatus. As many as six machines may be in action at the same time and the recording can be switched from one turntable to the other so no part of a program is lost.

About the time of the stock market crash, in 1929, commercial recording began. It came in with the depression and consequently got away for a slow start. Home outfits, placed upon the market for private use, had only a mild success. The aluminum record, which had been



[illegible] made in Germany. In circle [illegible]

Hear Themselves

NEW TRICKS

evolved by Victor H Emerson New York inventor after innumerable experiments with various metals, made rapid recording possible. In the first days of the commercial studios, these disks were employed almost universally. The difficulty is that they can be used only with thorn, cactus or casein needles. Steel needles, which give a maximum of volume and brilliance, are too hard.

Wax, or pressed, records, which take the steel needles and are the kind used for regular phonograph recording, give the finest results. But they are out of the question for quick delivery. To make each record requires half a dozen steps, including an electrolytic bath and a baking at high temperatures. It is from five to ten days before the record can be delivered and the cost of recording a fifteen-minute program runs to almost $100.

A couple of years ago, a record with a metal base and an acetate-composition covering appeared on the market. Four sprayings of the composition went on the metal and there was a delay of several days before the acetate was thoroughly dried. However, the records, which could be played with steel needles, were ready for delivery as soon as the cutting was done.

In the constant search for better and quicker methods, the engineers have worked out a number of innovations lately. One disk, imported from Germany, is said to give practically as good results as pressed records. It has a soft upper surface on a hard acetate composition base. The new disks come from Germany packed like stacks of pancakes within special metal containers. They are baked for two hours and hardened after leaving the cutting room and then are ready for delivery.

After the grooves are cut in the record, they are placed in this special heating chamber and baked for two hours to harden them. This is done only with soft surface records. Others are ready for delivery as soon as they are cut

Another innovation along the same line is a disk just announced by George W. DanJunas, an American radio pioneer. Also of an acetate composition, it is unbreakable, can be made in thirty seconds, and is ready for delivery the instant it is taken from the recording machine. It is said to be the product of more than five years of research and upwards of 20,000 experiments.

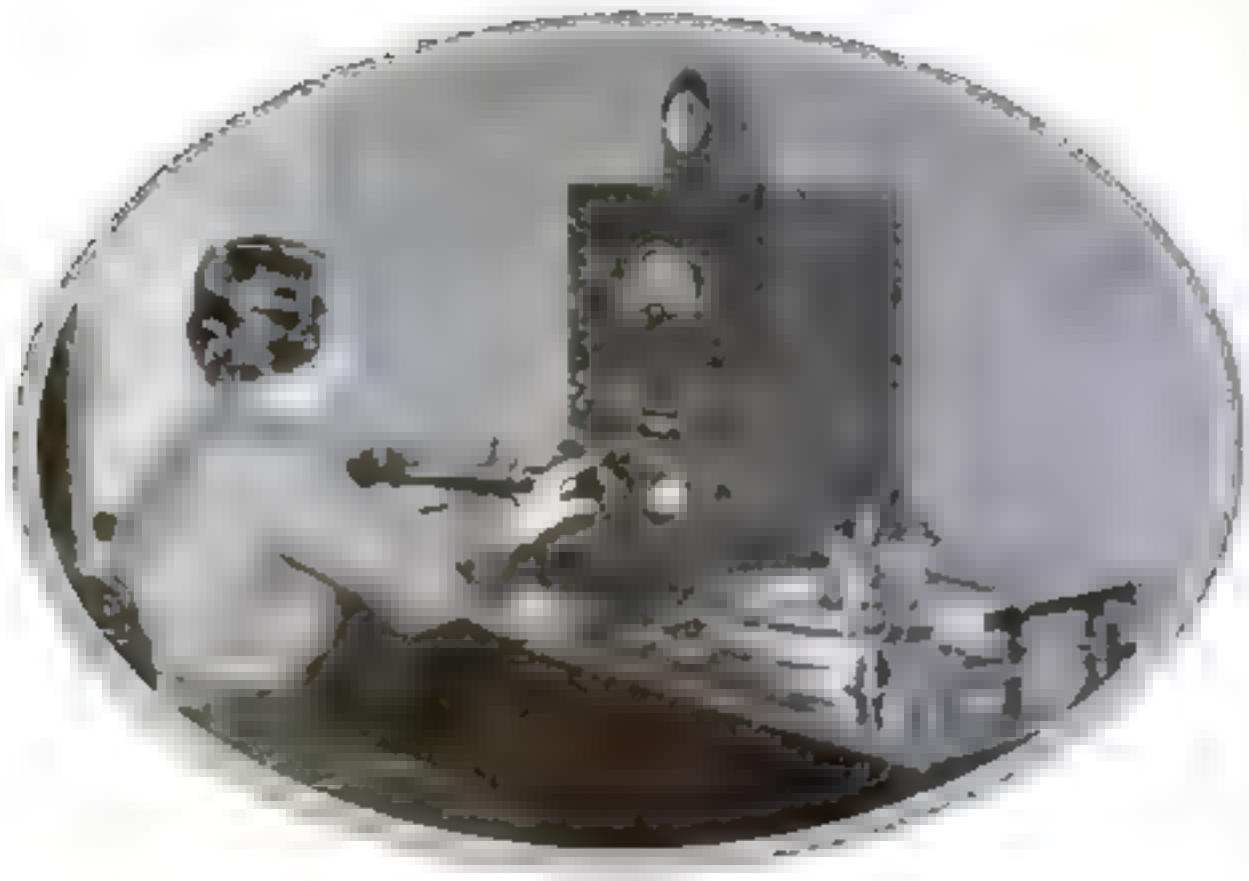
During the last election, radio recording was called into play by a number of politicians. One candidate ordered all of his opponent's speeches sent to him for study. Emphasis and inflection, not shown in stenographic reports of a speech, often play an important part in giving a twist to a sentence. For this reason, one lawmaker has suggested that all political speeches be recorded and placed on file.

In a hot local campaign in the East, two party orators broadcast speeches from big stations and had records made. More than thirty duplicates were run off and sent to smaller stations in the vicinity. During the last hours of the campaign, the air was plastered with their appeal to the voters.

Recording laboratories, however, are none too enthusiastic about taking the work of candidates. This fact dates to an experience several years ago. An optimistic politician ordered records of everything he said on the radio. He made innumerable speeches and then, when he was defeated, the war chest of his party was found insufficient to pay the bill.

When duplicate copies of a record are made, the first record is "rebroadcast" in the laboratory and other disks grooved by the recording machines. Usually, a fifteen-minute program fills two twelve-inch records. Sometimes, larger sixteen-inch records will hold the whole program, both faces of the disk being cut.

Almost every day, I was told, people come to the studios and have records made to send to friends or relatives



This picture shows the process of recording a radio program on aluminum records by means of a new apparatus perfected a few weeks ago. The work can be switched from one table to the other

abroad. The standard rate for such "talking letters" runs from $1.50 to $2.50, according to their length.

Lawyers are also using the recording service to supplement written confessions and testimony which they intend to introduce in court. Sometimes, witnesses maintain they did not know what they were signing in the written statements taken down by stenographers. With the records giving their testimony in their own voices, such retractions are made difficult.

In still another way, radio recording is figuring in legal action.

Recently, the Better Business Bureau of an Eastern city was on the trail of a group of gyp clothiers. When the dealers advertised on the air, offering sensational values far in excess of the real worth of the clothing, the Bureau had records made of the broadcasts. This evidence, and the threat of legal action, drove the shady merchants from the air.

In one New York laboratory, I was shown the beginnings of a curious library of recorded voices of the great. Whenever noted men or women make speeches over the radio, their voices are added to the collection. Political conventions and large gatherings increase the growing list of records. Besides its historical value, the collection has a present practical one. In programs, for instance, in which actors imitate the voices and speaking mannerisms of personalities in the news spotlight they rely upon the records for help.

Some months ago, a manufacturer put on a series of interviews with noted persons. Before the programs started, he made arrangements to have them recorded and after every broadcast presented a record of the interview to the distinguished guest as a souvenir of the occasion.

Similarly, orchestra leaders, like Paul Whiteman and Rudy Vallee, send records to radio stars who appear as guest artists on their programs. Vallee was one of the original users of radio recording. He started the practice of engaging new talent almost exclusively through records. New songs are sent to him on disks so he can select the ones best suited to his voice. Other singing stars of the radio are also receiving new numbers as records instead of as sheet music. It enables them to play the tunes over and over at home and learn them with a minimum of effort.

An improvement in recording, to be introduced within a few months, is a twin-track record designed to give "three dimensional" sound. Twin microphones, in different parts of the room, will pick up the sounds of an original broadcast. Recorded on the parallel grooves of the disk, the sounds will be reproduced simultaneously. The effect, according to the inventor, will be to give mechanical recording two ears instead of one—to give sound three dimensions just as stereopticon pictures give a sensation of depth as well as length and breadth.

Improved methods and an increase in the volume of business have cut the costs of radio recording until a fifteen-minute program is now listed at from $5.00 to $7.50, according to the kind of record used. Aluminum is the cheapest. The original cost was a dollar a minute. While the aluminum records require a radio-phonograph hook-up to get satisfactory volume, the acetate disks can be played on an ordinary phonograph.

As you watch one of these black disks being turned into a record, you see a tiny glistening thread stream from the cutting point as it plows its spiral groove in the surface. More than 1,000 feet of this thread is formed in cutting one side of a twelve-inch record and some 3,200 feet of grooving is required to hold a complete fifteen-minute program.

One of the biggest orders ever received by a recording laboratory came, not long ago, from a peanut distributing organization in the south. The company had put an elaborate and expensive program on the air in a chain hook-up. Then it had records made of the broadcast and sent duplicates to practically every independent radio station in the country. These stations used the records for fill-in programs. To see how the different announcers handled the material, the company ordered records made of many of the rebroadcasts which would not reach its home office in the south.

Other buyers of radio time are adopting the same plan. In order to get full benefit from an especially fine program, they are having it recorded and are sending duplicate disks to smaller stations for spot broadcasting.

On several occasions, manufacturers have sponsored programs which did not reach their part of the country after they had become interested in the feature through recordings. The Voice of Experience, for example, was sold to a midwestern *(Continued on page 112)*

To improve the harmony between herself and her orchestra, Gladys Swarthout has records made of her broadcast songs

Artist's sketch of the new amphibian plane designed by Captain Frank T. Courtney. The diagram shows how its unusual construction prevents ground-looping, a common fault in amphibians as at present built

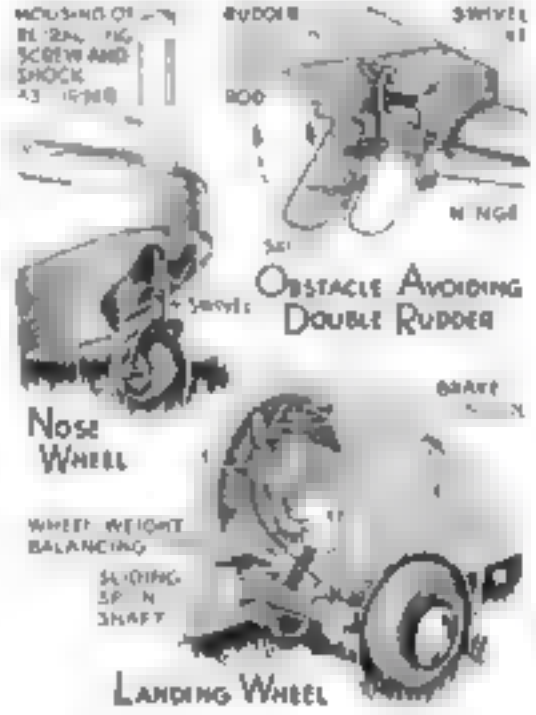
Safer Landings with

Three-Wheeled Amphibian

By STEWART ROUSE

LANDING on dry ground, a dangerous operation for most amphibian planes, is made safer by the unusual construction of a new craft of this type designed and built by Captain Frank T. Courtney, noted airplane designer. The use of an auxiliary swiveled landing wheel at the nose of the plane makes it possible to place the main wheels well back, preventing ground-looping without the usual risk of nosing over. Other construction details give this plane a speed and maneuverability not commonly found in amphibians.

To make the plane land on earth exactly as on water, the main landing wheels were put on at the main step of the hull, which is the part that touches first in a water landing. With these wheels attached so far back, the plane would, of course tip forward on its nose as the speed slackened, so a retractable swiveling nose wheel was installed. This nose wheel absolutely cures the common tendency of amphibians to nose over when brakes are applied. Having the main landing wheels so far behind the center of gravity also prevents skidding ground-loops, which most amphibians hasten to perform if one wheel strikes an obstacle, with consequent terrific wrenching and injury of the airplane's structure.



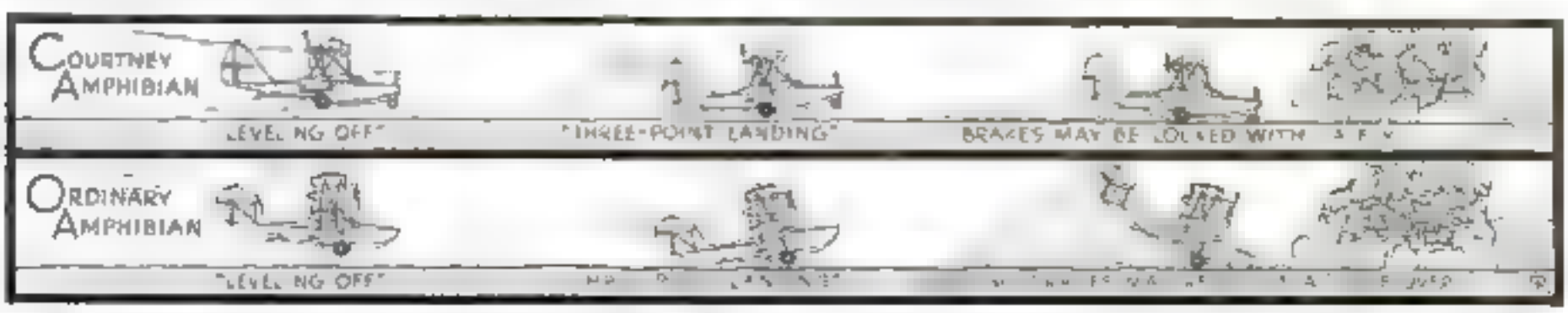
Details of the nose wheel, obstacle-avoiding rudder, and main landing wheels of the plane

In the water the plane handles nicely, having a double water rudder which is hinged to move upward on striking an obstacle. It is connected so that it steers in conjunction with the air rudder from one set of controls

Retraction of the main landing wheels into the hull is complete, and the nose wheel is only slightly exposed when retracted. Each main wheel is mounted on a heavy crank attached to a sliding splined shaft, rooted in a large collar. To retract the wheels, each splined shaft is rotated until its wheel-supporting crank is vertical. Then a giant turnbuckle draws the shafts inside the hull, pulling the wheels into their spaces. Retraction of the nose wheel is accomplished by a screw jack.

Streamline design gives this plane a speed of 151 miles per hour. It is claimed that the design of the motor nacelle which houses the 365 horsepower engine and its thirty-one-inch drive shaft, conserves about forty-five horsepower usually wasted. The oil tank forms the front rim of the low-drag engine cowl.

The five passengers carried by the airplane enter the cabin by opening the right half of the windshield. A fore hatch and an after hatch give access to huge luggage compartments. The entire airplane is of metal, excepting the wings, which are of conventional wooden construction with metal fittings.



The drawings above show how the Courtney amphibian differs from the ordinary land-and-water plane in landing on dry ground. The main landing wheels are properly placed to permit the plane to land gracefully, and the nose wheel prevents nosing over

COASTING *with a* *Parachute*

IS WORLD'S MOST THRILLING SPORT

An experimental paper parachute hovering above the observatory built on a peak in the Pyrenees for a study of prevailing winds

BY HITCHING a sled to a parachute, a dare-devil Frenchman has devised the most thrilling sport in the world. Down snow-covered slopes so precipitous that any other way of attempting them would be folly, he coasts at breath-taking speed, the 'chute billowing behind him and providing his only security against disaster.

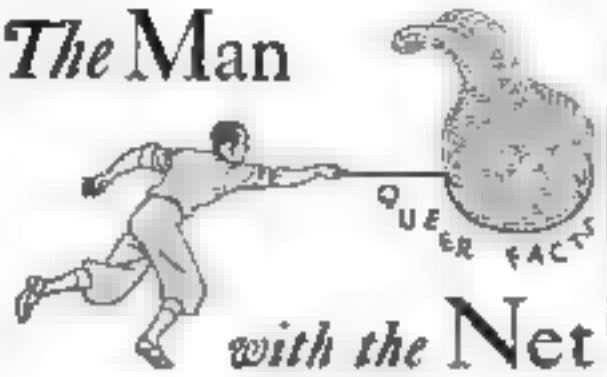
The inventor of this exhilarating pastime is Hubert Garrigue, government meteorologist at an observatory in the French Pyrenees. For years he has been fascinated by the study of the tempestuous winds that sweep up the sides of the peak on which the observatory stands, and he has made elaborate observations of them by releasing miniature paper parachutes to be carried aloft by the air currents. One day the idea occurred to him of riding the wind himself.

He built a sled with ski-shaped runners, tilted slightly outward from each other to give stability and avoid pitching the daring rider from his large, woven saddle. To this contrivance, Garrigue attached a large, self-opening parachute with an area of more than ten square yards. At first gingerly and then with increased confidence, [illegible] tried out his strange apparatus on the mountain slope. He learned to [illegible] and glide with ease down slopes of terrifying steepness, pitched at a slant of forty [illegible]

It is a thrilling experience. Loose snow, borne on the rising winds, stings the rider's face and all but blinds him as he plummets downward at express-train velocity. One moment a gust checks his plunge, and, the next, an air pocket drops him with a sensation akin to that experienced in a falling elevator. By leaning to one side or the other, the rider steers his vehicle, sheering away from bare rocks that would rip his parachute to shreds and send him hurtling to destruction. Here is the time-honored sport of coasting raised to a new peak of audacity!

Nor is Garrigue content, like most coasting enthusiasts, to plod patiently back for the next thrilling descent. His next experiment, he says, will be an attempt to make the wind carry him uphill. Entrusting himself to the mercy of gusts of extreme violence, sweeping upward through narrow, confined passages in the face of the mountain, he believes that his parachute will haul him up slopes as steep as fifty-five degrees and back to the starting point.

The Man with the Net



IN SEAWATER, *gold is five times as plentiful as silver*

HAILSTONES *in South Africa recently killed a tortoise big enough to support a man on its back.*

JAPANESE *sharks lay the biggest eggs of any living creature. They are twice as big as ostrich eggs.*

THROUGHOUT *the world, twins come once in a hundred births. In Ireland, they come once in seventy-two births.*

YOU CAN *look two ways at once in a new whirling microscope which is being used by scientists to compare different groups of bacteria.*

ELECTRIC *fish can generate enough current to ring a doorbell.*

THE AVERAGE *boy grows eight inches between fourteen and sixteen.*

A HORNED *toad isn't a toad; a silkworm isn't a worm, a glass snake isn't a snake; a white ant isn't an ant. A horned toad is a lizard a silkworm is a caterpillar a glass snake is a lizard and a white ant is a termite, belonging to another family of insects.*

SNAILS *have replaced men in cleaning moss from citrus trees on the island of Jamaica.*

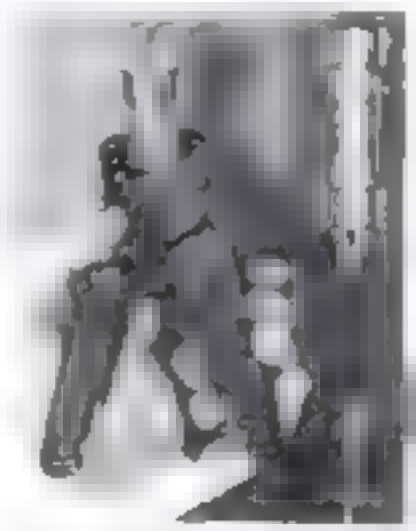
WHEAT *that grasshoppers won't eat is being planted in North Dakota. Developed at an agricultural experiment station near Fargo it is known as Ceres wheat. Why the insects avoid it is unknown.*

FLOWERS *run temperatures. French scientists have found that when the nasturtium, dandelion and sweet pea are budding, they develop temperatures several degrees above that of the surrounding air.*

VACCINE FOR INFANTILE PARALYSIS

A new vaccine against infantile paralysis, developed in the research laboratories of the New York City Health Department, received its first public use the other day when twenty-five children were inoculated. Physicians hoped the event marked the turning point in the long fight to check the dreaded disease in the way diphtheria and other childhood diseases have been conquered. Tests conducted by Dr William H. Park, director of the laboratories, and his assistants, showed that children can be made immune to infantile paralysis but the duration of immunity is not known. The new vaccine is prepared from the spinal cord of a monkey that has the disease

One of first children treated is inoculated with new serum



Above insulated tool being used to remove burned out fuse. Right, prongs being used to test receptacle. Lamp shown by a row lights when current flows

SHOCKPROOF TOOL TESTS WIRES

Testing electric outlets to see if they are "live," extracting blown fuses, and tracing trouble in open circuits, are among the varied tasks performed by a versatile electrical tool just introduced. Because the device is built of shockproof materials, its plier jaws provide a safe means of pulling a fuse. At the opposite end of the implement are a pair of prongs that may be inserted in an electric outlet or held across a pair of wires under test. A miniature lamp, built into the tool, lights if there is current on the line. As only one hand is used, it is almost impossible to receive a shock while using the device thus.

FRANKLIN'S GLASS ORGAN STILL USED

Once popular among musicians the glassharmonika, which emits its tones from revolving glass bowls, is today one of the rarest of musical instruments. Only three specimens are reported in existence in the world—the one shown here which is in the possession of Bernhard Fritsch, of Cincinnati, Ohio and the others abroad. The instrument's forty-two glass bowls, of graduated sizes, are mounted on a common axis and revolved by a foot treadle. To play an air, the performer applies his moistened fingertips to the rotating bowls, which are arranged chromatically. The instrument was the invention of Benjamin Franklin. The story goes that while employing a primitive device for generating static electricity, consisting of a revolving sulphur globe rubbed with the hands, he discovered the principle on which the glassharmonika operates.

Playing rare instrument by touching bowl with damp fingertips

DOGS GET NEW SERUM FOR DISTEMPER

Dr Geo. W Little inoculating a dog with a new serum a prevented sickness

IMMUNIZING a dog against distemper, one of the deadliest of canine diseases, for the rest of its life is reported to be made possible with a single injection of a new serum preparation. Developed by Dr George Watson Little, New York canine specialist, the treatment consists of administering simultaneously a dose of the living virus of the disease and a concentrated serum obtained from dogs which have had distemper. Veterinarians who have tested the preparation report that dogs thus inoculated, by means of a hypodermic needle, may apparently be exposed to the disease immediately or at any future time without contracting it. The treatment also serves as a preventive one for dogs already exposed, the tests indicate. Immunizing treatments for distemper have hitherto required repeated injections instead of a single one, and have not conferred immediate protection. The treatment is a simple one and is said to cause little pain or inconvenience to the subject.

LIFE BELT HAS LIGHT

To FACILITATE the rescue of survivors of a maritime disaster occurring at night, a life belt with a built-in electric lamp has been invented by a young engineer of Boston, Mass. The illuminated beacons would guide rescue craft to persons struggling in the water. Current for the lamp is furnished by an ingenious, self-acting battery comprising a pair of dissimilar metals, and operating only when immersed in water. Thus it remains inactive until the wearer of the belt plunges into the sea, when the lamp automatically lights. Similar automatic beacons may be installed in lifeboats, the inventor suggests.

CURRENT HEATS LADLE

HEATED by electricity, a new ladle for use in home workshops or small commercial shops provides a handy means of melting such materials as paraffin, solder, insulating compounds, pitch, and low-melting-point alloys. It may also be used to draw off molten material from a larger container and keep it hot until it is ready to be poured, as shown in the photograph above. An electric heating element in the base makes temperatures up to 600 degrees F. available, current being supplied from any convenient outlet by means of a cord. Various sizes of the new ladles are available ranging up to eight pints.

WHEN AN EXPLOSIVES TRUCK EXPLODES

WHEN brightly painted trucks labeled "Explosives" roll along the public highways, most car drivers give them a wide berth and wonder what would happen if one should blow up. Photographs reproduced here taken after a truck carrying quarts of nitroglycerin exploded provide the answer. The machine was traveling along a dirt road in the Texas panhandle region when, for some unexplained reason, its contents were detonated. The truck and its driver were blown to bits and a hole twenty feet wide and six feet [illegible] was torn in the hard-packed road. Fragments of the motor, like the one illustrated, were the largest pieces found intact. Debris was scattered for half a mile around, and the blast was heard fifteen miles away.

Above, a [illegible] of the largest pieces of the truck [illegible]

The explosion of the truck load of [illegible] left a crater twenty feet wide in a hard-packed dirt road and [illegible] dead a

All Shipshape

By
BERTON BRALEY

MY husband is really a model
(A ship-model husband, I'd say)
For there is a twist in his noddle
That makes him peculiar that way
He planes and he stains and he whittles,
Gets covered with varnish and glue
And hardly sits down to his victuals
When he's got a model in view.

Brigantines, barkentines, schooners and yachts,
These are the toys that he plans and he plots,
Dinghys and whaleboats
And motor and sail boats
Filling up all the available spots!
Models in living room, bedroom and bath
Fashioned in beauty, says he,
Still, I assert with some natural wrath,
Dusting 'em's up to ME!

He steals from my work-box, he trifles
With pieces of silk and of net,
Swipes thread for his rigging, and rifles
The tools of my manicure set.
You cannot sit up to a table
You cannot sit down in a chair
But what there's a spar
Or a mucilage jar
Or a keel or a rudder post there!

Galleons and caravels, clippers and scows
Barges with dragons and things on their bows,
Galleys and proas
And arks like old Noah's
—Pretty to look at, but—pity a spouse!
Pity a housewife who's hemmed all about
Cluttered with craft of the sea,
Models of ships are a treasure, no doubt,
Fun to exhibit, a joy to work out,
Nevertheless I am longing to shout
"Dusting 'em's up to ME!"

SMOTHER FIRES WITH ASBESTOS

An ASBESTOS blanket, introduced in England as a new motor accessory, quickly smothers a fire without damage to the car's engine. When folded up, the blanket makes a small parcel that is carried near the driver's seat, within reach in case of an emergency. If a fire starts, it is a second's work to open the blanket and toss it on the flames.

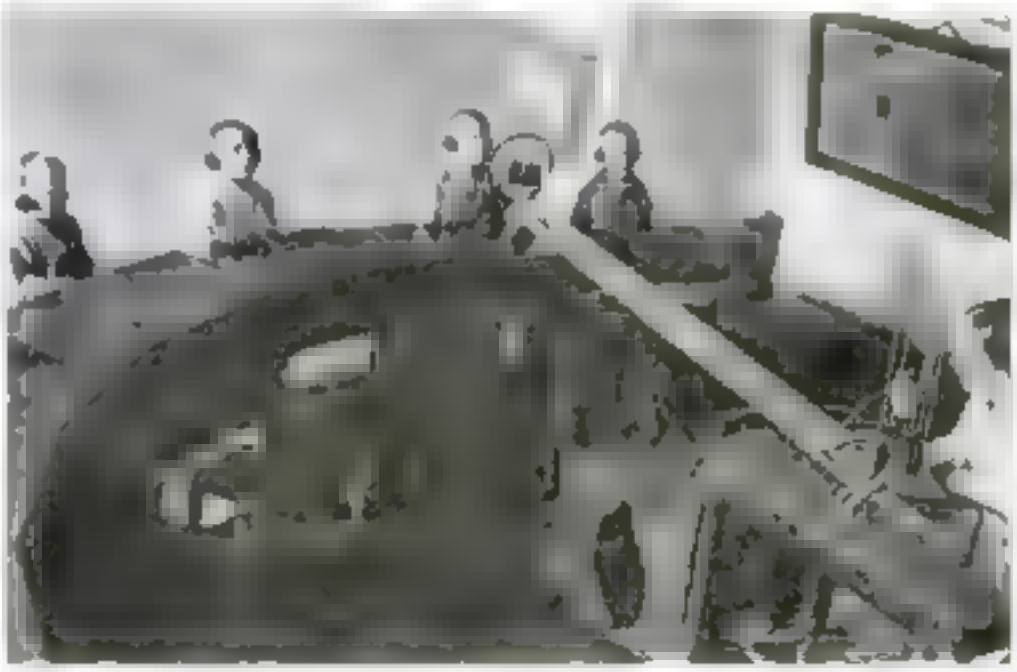
Using an asbestos blanket to smother a fire

MACHINE CORRECTS GOLF SWING

GOLFING novices quickly learn to swing a club in the proper arc, it is said, with the aid of an improved practice device introduced in a Chicago school. The student stands within a spiral metal rail that guides his club throughout the stroke, from address to follow-through. By letting the club ride lightly along the guide, the tyro learns the feel of a swing made with perfect form, and soon acquires sufficient skill to dispense with this artificial aid. The photograph at the left shows the device in use. After a little practice with the device, it is said, correct use of the club becomes habitual

MIKE REVEALS SPEECH DEFECTS

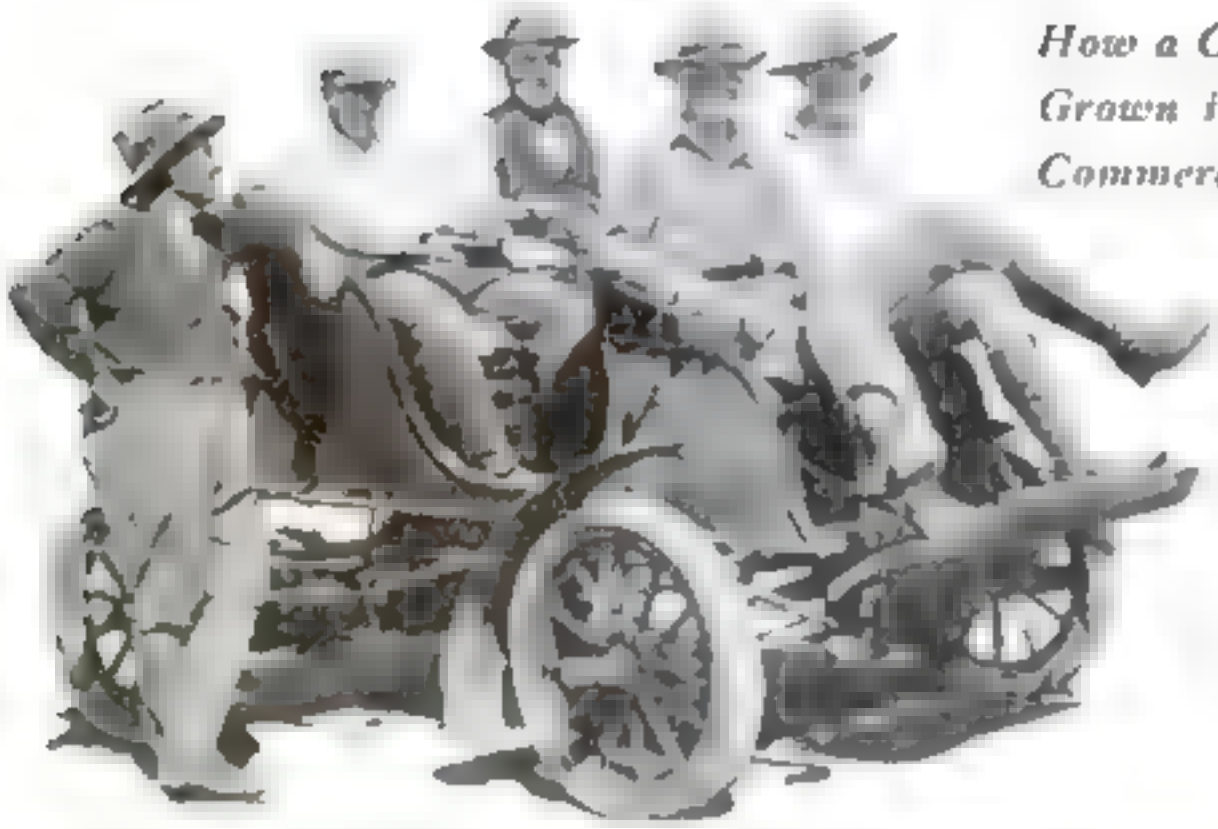
TO AID school children to overcome defects in speech and hearing special classes have been instituted in a Russian laboratory equipped with innovations in modern electrical sound apparatus. One of these is a microphone on a swinging boom supported by a wheel at the end. By means of a handle within arm's reach, the instructor may roll the microphone along a semicircular row of desks and place it before each one of the pupils in turn. His speech, amplified and heard through a loud-speaker, may be compared with that of his fellow students and thus corrected. Each pupil is also provided with earphones for use in hearing exercises, designed for improving the hearing of children deficient in this sense.



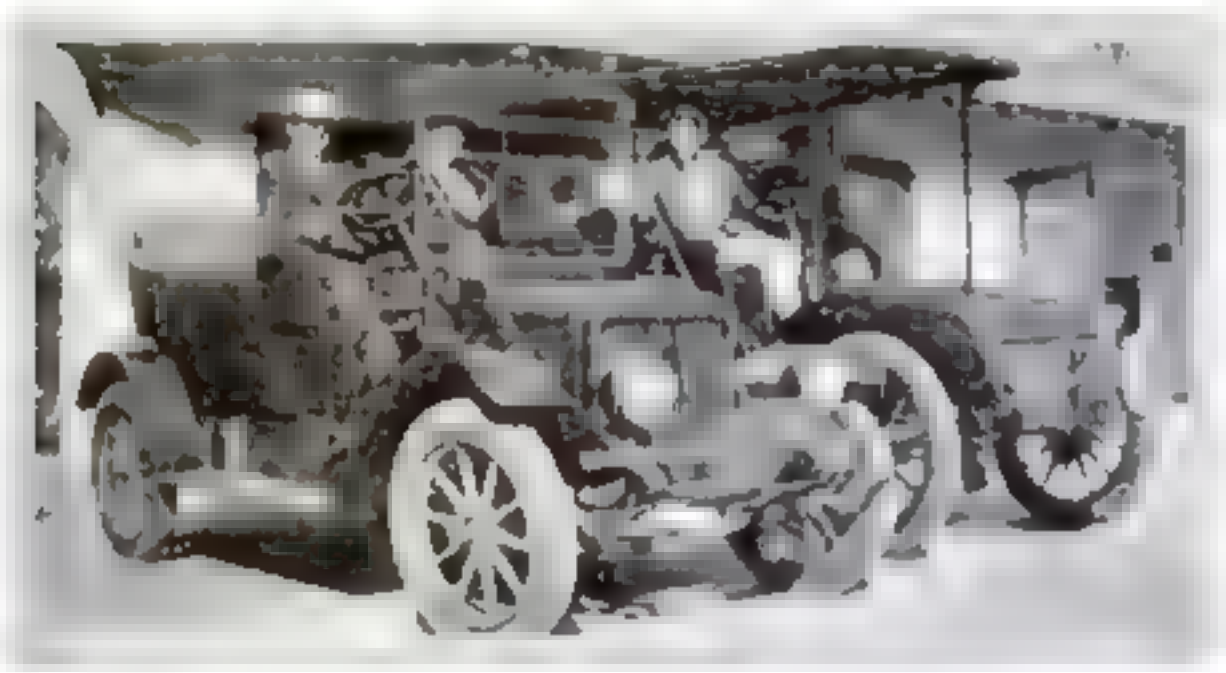
Microphone on traveling boom used in correcting speech defects of Russian children

Fleet of Antique Cars Is

How a Californian's Odd Hobby Has Grown into a Traveling Museum of Commercial and Historical Value



This 1903 Pierce Arrow Stanhope model plainly shows its descent from the once popular Stanhope horse-drawn phaeton, now nearly forgotten. Rumble-seat passengers perched on the front

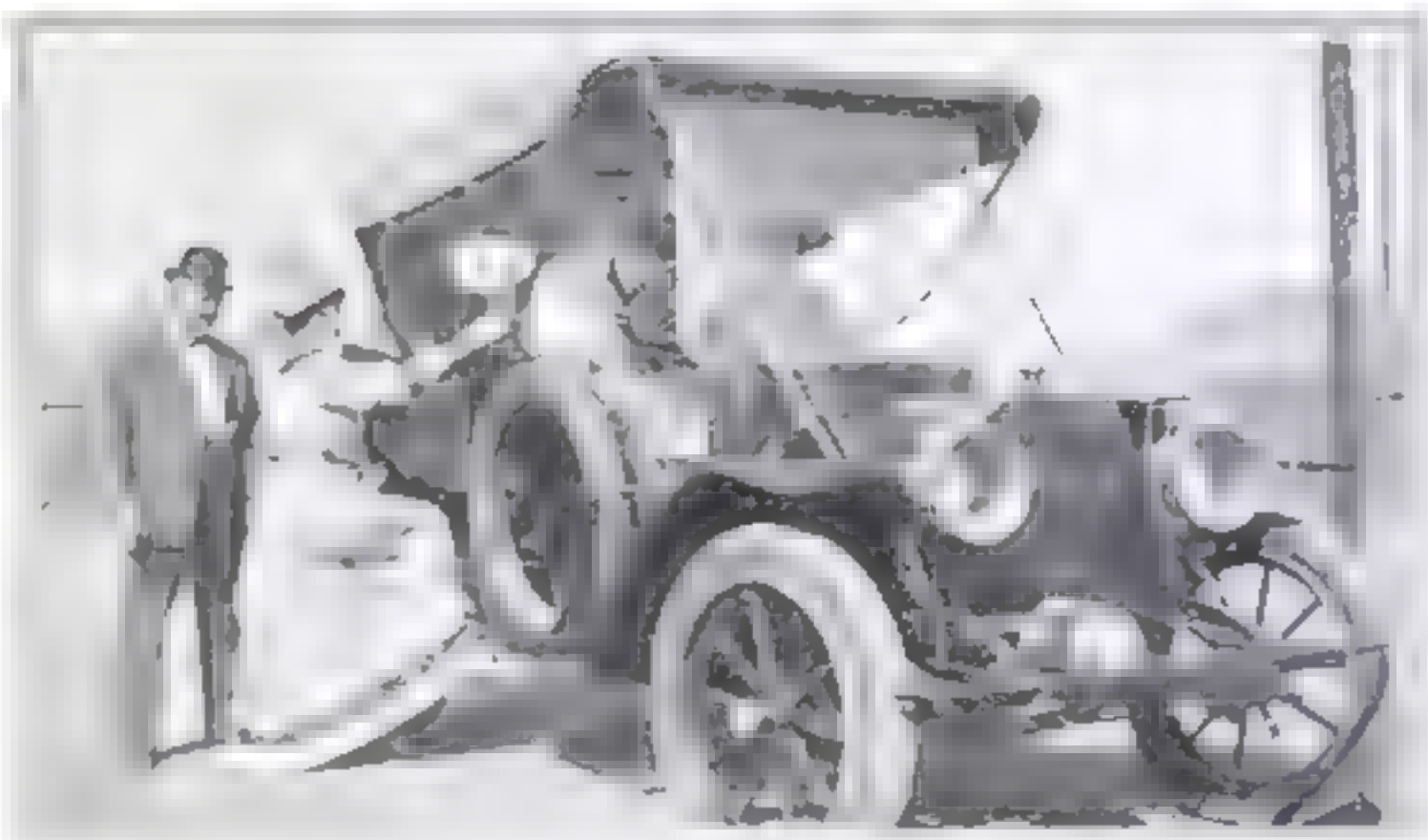


WHEN a movie producer wants a car of ancient vintage, or an automobile maker wishes to exhibit a model of long ago, the chances are that Harry E. Twohy, of Los Angeles, Calif., can fill their needs. Just as others collect old coins or furniture, he collects old automobiles. Today he owns what is probably the world's largest fleet of antique cars in running order. A surprisingly profitable business has developed from the collection that he started as a hobby, some years ago, with the purchase of a 1903 Pierce Arrow.

Wherever Twohy drove this acquisition, crowds gathered. A merchant, seeing the display value of the relic, paid Twohy to place advertisements on it. Other offers followed. The car went to an auto show as an exhibit. Then a movie company hired it, to put atmosphere into a film depicting the days when automobiles were "horseless carriages."

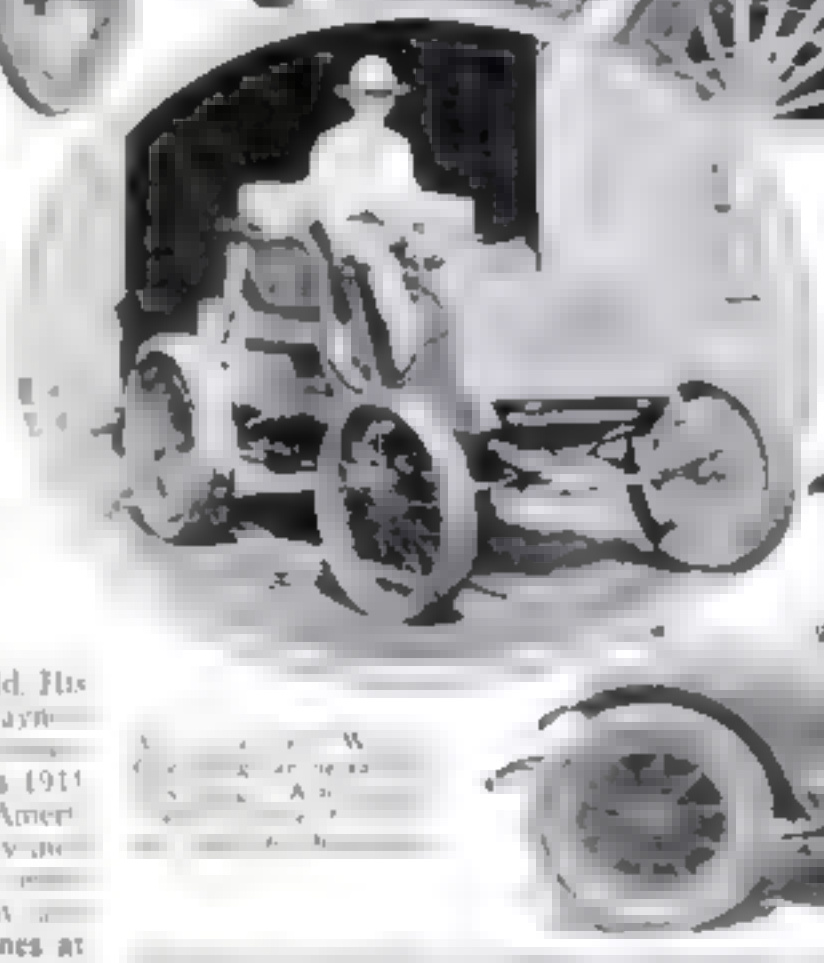
Twohy began buying obsolete cars, repainting and reconditioning them, and sending them chugging forth to advertise his enterprise. When his machines found increasing demand for auto shows, parades, motion pictures, and advertising purposes, he offered cash rewards for information as to where cars twenty years or more old could be found. Some he came upon, dismantled, in cellars and garrets. One venerable car turned up in a barn on an isolated farm, in the state of Washington, twelve miles from the nearest road. Thirty years before, a farmer had bought the machine and dragged it with horses up a stream bed to his farm, to await the coming of a highway that

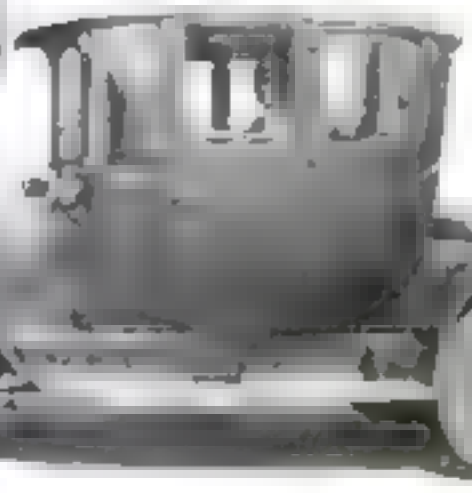
Above, a reminder of the days when motorists were divided over the relative merits of gas and steam. Harry E. Twohy's 1911 model White Steamer is shown alongside a 1901-model, two-cylinder Packard. The photograph was taken at a movie studio



A Cadillac touring car vintage of 1909, as it appeared at a Los Angeles auto show with the passengers and driver clad in the motoring costumes of the period. Note the acetylene headlights, kerosene side lamps, and spring-starting mechanism

Big Money Maker





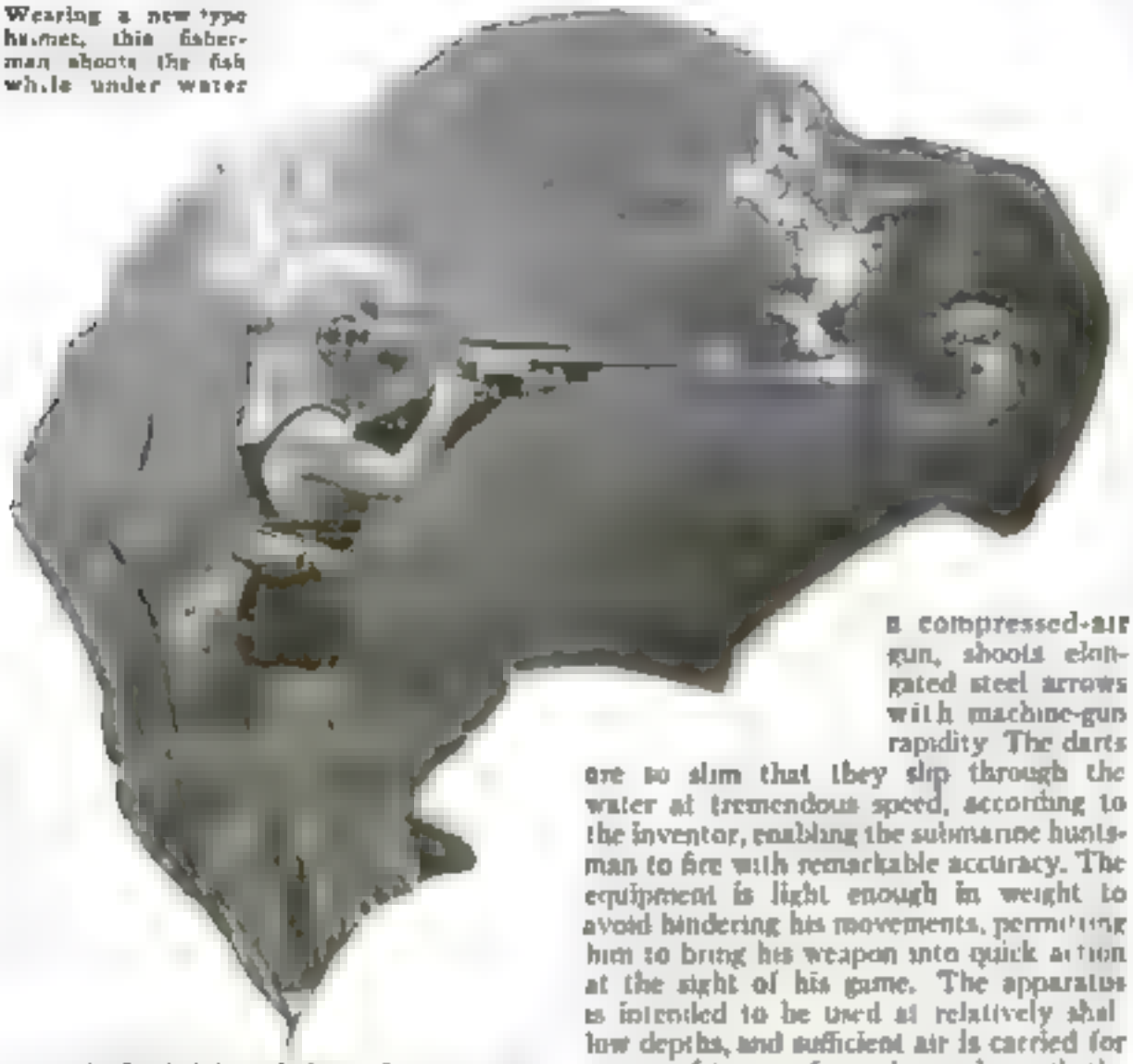
never was built. Twoby dragged it back again. The relic cost him ten dollars to buy and nine hundred to put in running order. It has repaid the investment many times over.

Today his collection of antique vehicles, none of them less than twenty years old. His trophies include an 1898 Haynes-Apperson, a [illegible] order car of the same year, a 1911 White Steamer and a 1912 American. Underslung with forty-inch wheels. All his machines run under their own power, but Twoby and his two sons are the only ones at hand who can drive them for their users. A modern motorist would be at a loss to handle these old timers, with tillers instead of steering wheels, clutches that push in to start the car moving; and gear-shift and brake levers outside the driver's seat. Equally strange to the present-day driver are their drip-feed oiling systems, single-tube tires, and dry-cell ignition.

Upkeep and storage for the growing collection present serious problems. Spare parts no longer are available from the makers and must be made to order in a machine shop. Tires can no longer be obtained for some models. In some cases he has been forced to reject cars that really belonged in his collection, because tires could not be secured for putting them on the road. Lest fire or accident wipe out the fleet, Twoby keeps his machines scattered in private garages. With the passing of time they will become increasingly valuable and irreplaceable—a veritable museum on wheels, and a profitable one.

One of Twoby's rare specimens—a 1906 Buick touring car—as it appeared in a scene of a recent motion picture showing college life a quarter century ago. The driver's costume is also of the period

DIVER NOW SHOOTS FISH UNDER WATER



Wearing a new type helmet, this fisherman shoots the fish while under water

SHOOTING fish with darts, from a point of vantage beneath the waves, is envisioned by a French inventor who has just constructed a remarkable diving kit for the purpose. A light helmet and a cylinder of compressed air enable the diver to breathe under water, while another tube leads from the tank to one of the strangest weapons ever devised. This invention, a compressed-air gun, shoots elongated steel arrows with machine-gun rapidity. The darts are so slim that they slip through the water at tremendous speed, according to the inventor, enabling the submarine huntsman to fire with remarkable accuracy. The equipment is light enough in weight to avoid hindering his movements, permitting him to bring his weapon into quick action at the sight of his game. The apparatus is intended to be used at relatively shallow depths, and sufficient air is carried for a stay of twenty-five minutes beneath the surface. In the accompanying illustration, our artist depicts a diver employing this novel means of fishing. The inventor says that, with his new apparatus in good working condition, the sport is perfectly safe and should prove popular with those living near the sea or on the banks of large lakes

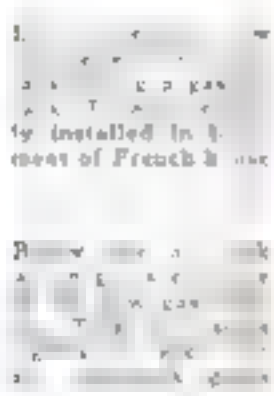
SPECIAL PUMP SERVES OIL TO MOTOR CARS

Motor oil is vended after the manner of gasoline by a pump especially designed for the purpose, recently exhibited to automobile men. This dispenser is replenished with oil in sealed, ten-gallon containers. Knobs on the face of the machine are adjusted to the quantity and grade of oil desired, which is delivered through a flexible hose to the car's crank case

MAKES VIOLET PERFUME

After years of research, a way has been found to manufacture irone, the substance responsible for the scent of violets. The discoverer of the synthetic method of manufacturer is Dr. Albert Verley, a French scientist who has long specialized in perfumes.

GASPROOF SHELTER PUT IN BASEMENT



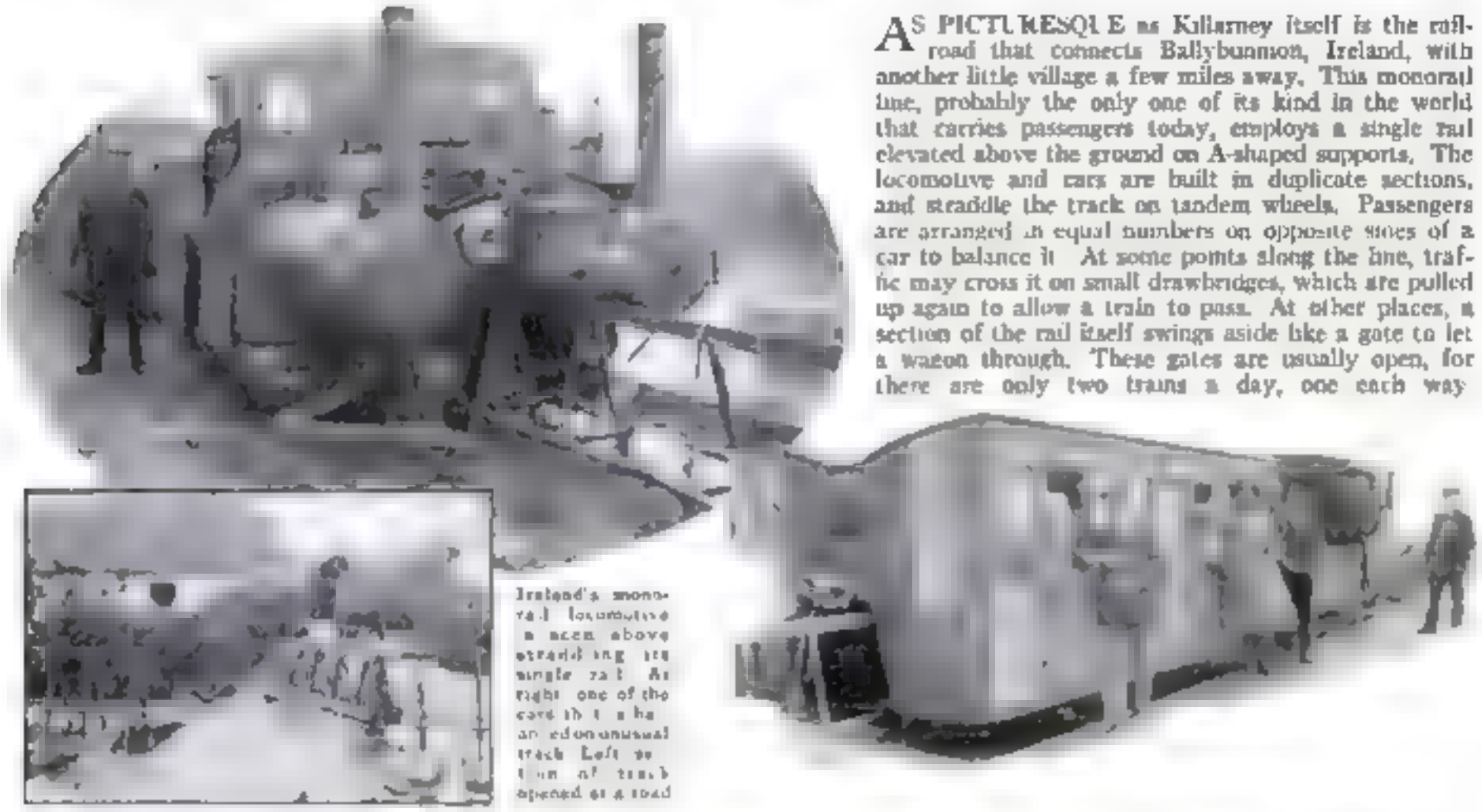
INVENTORS in European capitals have repeatedly demonstrated their anti-gas shelters for civilians. Now comes news that a French apartment house has pioneered in installing such a shelter in its basement. Capable of housing ninety persons, the shelter is entered through an air lock that provides a tight seal against gases. An electrical air-purifying [illegible] ventilation, drawing air from [illegible] through a filter that removes [illegible] tain. In case this equipment [illegible] ventilating apparatus may [illegible]

PARCELS WRAPPED FAST WITH NEW-TYPE PAPER

A COMBINATION wrapping paper, with which fragile articles may be wrapped for mailing in a single operation, has just been placed on the market. Formerly two wrappings were required, one with stiff board and one with paper. The new material has an inner lining of tough, cushioning material, while the exterior is a plain paper surface, firmly attached to it. The combination material folds around corners and over sharp edges with the ease of ordinary wrapping paper. It is supplied in sheets and rolls of various sizes.

Unique Irish Trains Run on One Rail

AS PICTURESQUE as Killarney itself is the railroad that connects Ballybunnion, Ireland, with another little village a few miles away. This monorail line, probably the only one of its kind in the world that carries passengers today, employs a single rail elevated above the ground on A-shaped supports. The locomotive and cars are built in duplicate sections, and straddle the track on tandem wheels. Passengers are arranged in equal numbers on opposite sides of a car to balance it. At some points along the line, traffic may cross it on small drawbridges, which are pulled up again to allow a train to pass. At other places, a section of the rail itself swings aside like a gate to let a wagon through. These gates are usually open, for there are only two trains a day, one each way



Ireland's monorail locomotive, seen above straddling its single rail. At right, one of the cars which has an odd-numbered track. Left, section of track opened at a road

NEW AIRPLANE WINDOW KEEPS RAIN OUT EVEN WHEN OPEN

A WINDOW that can be kept wide open without admitting a drop of rain or a flake of snow has just been perfected for airplanes. By this feat, engineers of the National Advisory Committee for Aeronautics enable a pilot to enjoy unobstructed forward vision regardless of the weather, removing one of the greatest of present hazards to aviators. Tests at Langley Field, Va., led to the development of the new window. The "N.A.C.A. Rain Vision Windshield" of which it is a part, comprises three panes of conventional type and two of the new windows, one being placed at each side of the tapered cabin for use when the regular windows are obscured. By inclining his head ten inches in either direction the pilot may obtain a clear view past the nose of the plane and along the corresponding side. Rain is kept from entering and blinding the pilot by a twofold expedient. The main wind stream, with the raindrops it bears, is led past the open window by skillful streamlining worked out in wind tunnel tests, of which an important part is the curved forward edge of the window and its protruding, air-deflecting metal ledge. To aid in preventing the passing wind from entering his cockpit, the pilot can increase the air pressure in his cabin slightly by letting in air through a controllable inlet, such as is used in many

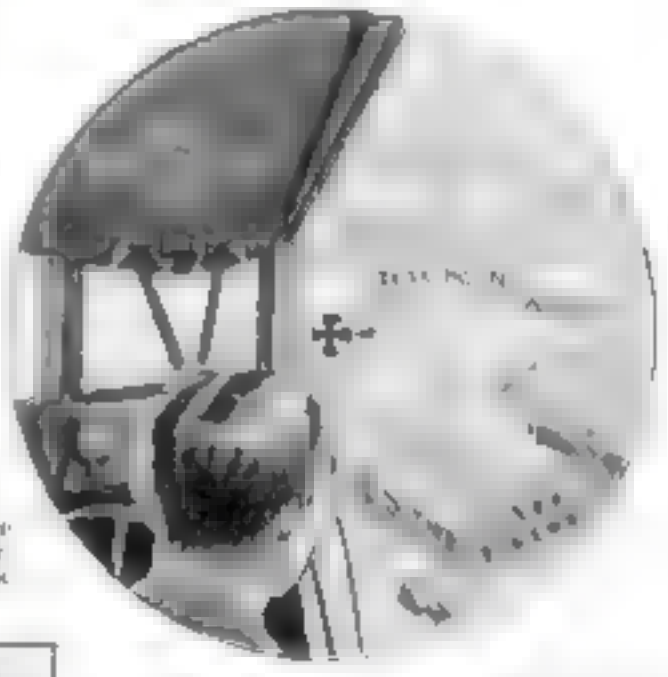
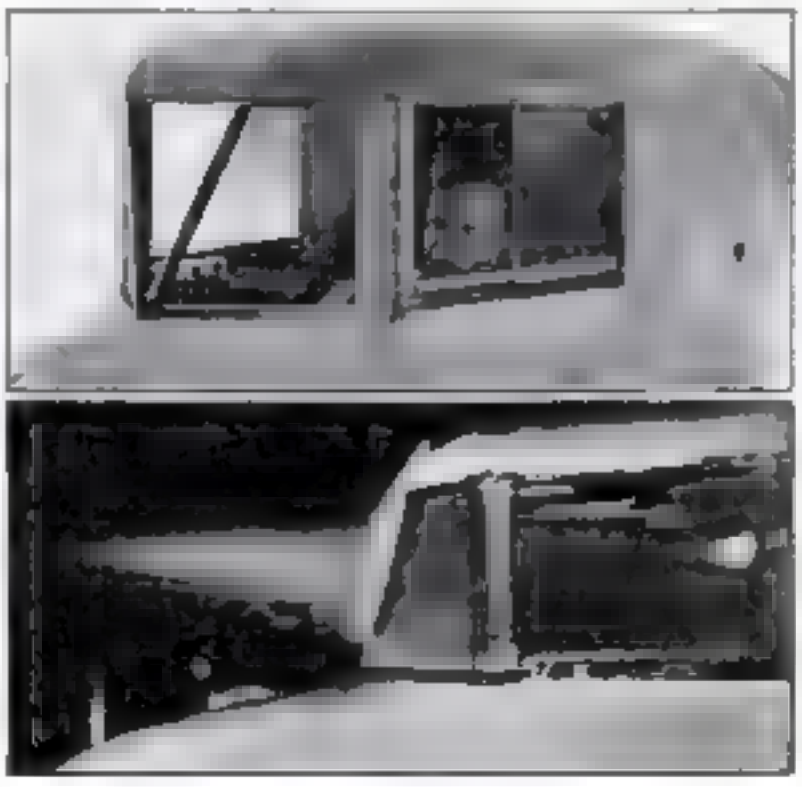
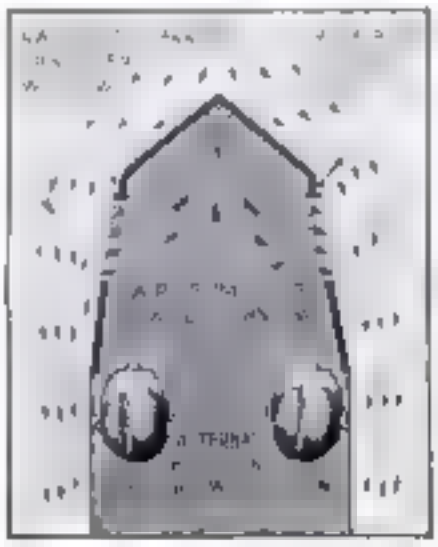


Illustration gives clear idea of how pilot gets an undimmed view ahead regardless of the weather

The two views below show a full-sized model of rain-vision windshield being drenched during critical test in wind tunnel to show its performance under conditions found in actual use



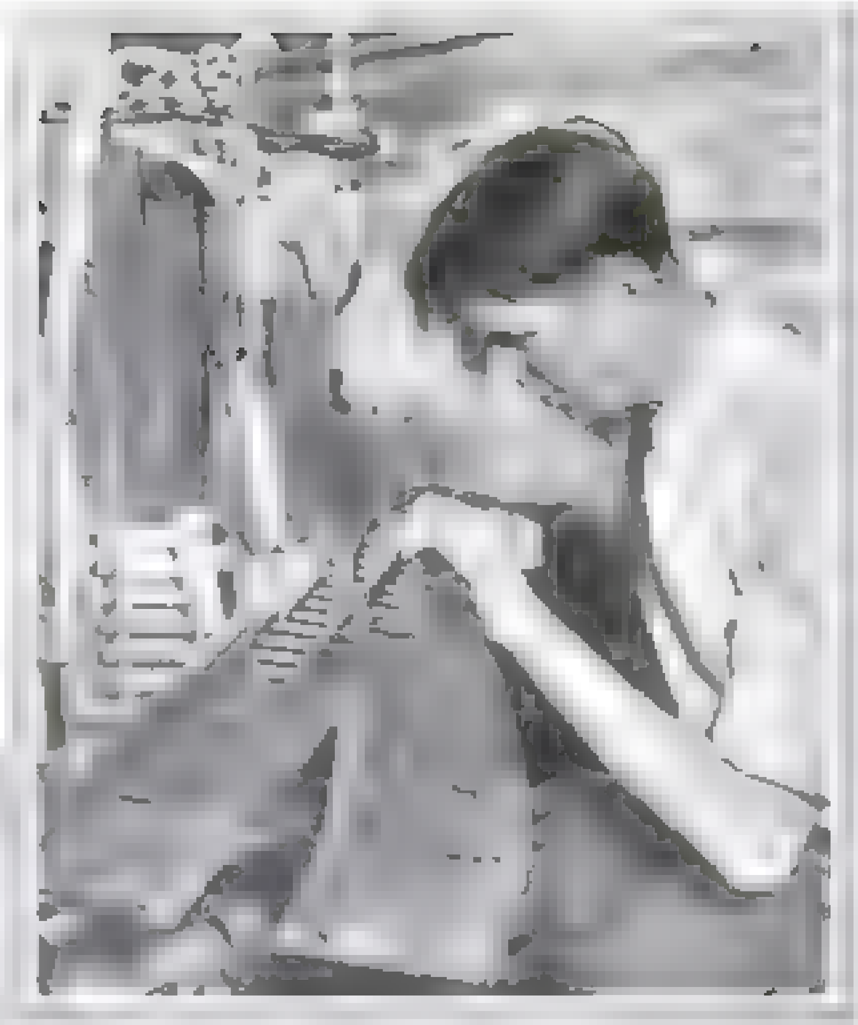


This diagram shows how shape of window deflects wind and keeps rain from entering the cockpit

modern planes for ventilation, having its intake at the lower front of the fuselage. In consequence, there is set up a gentle air current blowing out of the window, as a further barrier to raindrops coming in. When a full-sized model of an airplane fuselage was set up in a wind tunnel and drenched with a spray of artificial rain, none entered the open window. The new window is expected to be a special boon to pilots in the critical moments of take-off and landing, when clear vision is of vital importance. It is said to be equally adaptable to the control cabins of airships in which rain-clouded windshields are as much of a safety problem as in all other types of heavier-than-air craft.

Realistic Model Railway

FILLS A BASEMENT



[illegible]

A RAILROAD line suspends operation when S. G. [illegible] Conn., tends his furnace. The system, which he calls the Spring Glen [illegible] Lines, is one of the most elaborate model railways in the world. [illegible] while a branch route crosses [illegible] the front of the bin. [illegible] of coal, the bridge [illegible] ls flash danger al alone [illegible] roll automatically to a stop. The [illegible] is a maze of in[illegible] four relays and eighty-three sep[illegible] being employed on one section of tr[illegible] rest on 3,600 handmade ties spaced along a gravel roadbed [illegible] numbering more than 200, ar[illegible] ons. Scenery constructed to [illegible] a realistic setting for the tracks

Entrance of the tunnel th[illegible] under the coal bin. N[illegible] agone. The insulators are made of vest buttons that are joined tog[illegible]

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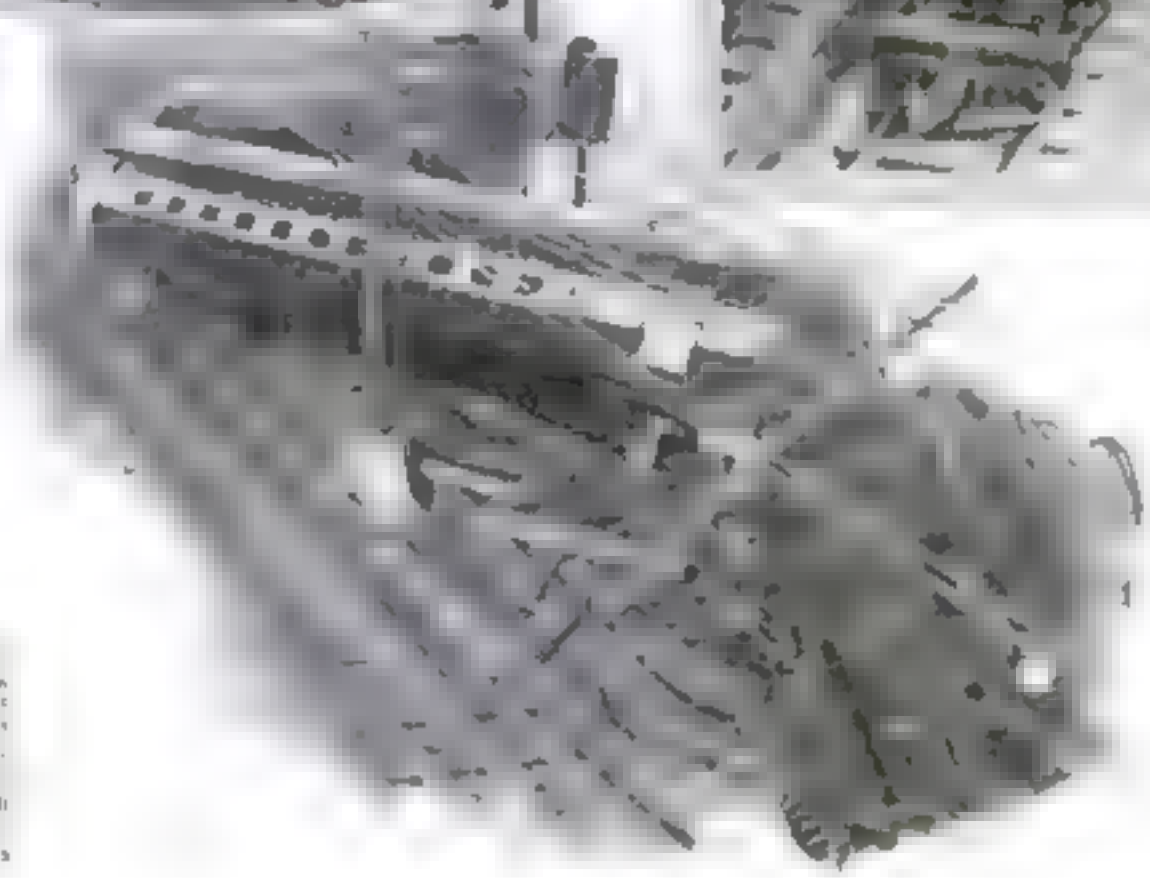


Plants *that* Feed *Each* Other

FOUND WITH YOUR MICROSCOPE

Only a part of the fungus structure of toadstools and mushrooms is visible above the ground. Underneath is an extensive root-like network, the mycelium

Left, root hemycelium of a toadstool. Above, a plant partnership of alga cells and fungus strands

Above, a dead tree limb, on which a fungus is growing. In this case, the fungus gets its own nourishment from the decaying wood

Spores produced by gill plate on a toadstool. The dark mass at the bottom of the print is the gill surface

YOUR microscope will reveal to you one of the wonders of the Plant Kingdom—a strange partnership in which two plants have pooled their resources, with apparent advantage to both.

You are, no doubt, familiar in a general way with lichens, those formations that grow on the barks of trees, the sides of rocks, and fence rails. You may have noticed how frequently they are the first living things to appear on rocks in a quarry, on surfaces left exposed by the cutting away of stone. They flourish there, without soil and, to the casual observer, apparently without other means of obtaining food.

How can the lichen thrive on bare rock, where soil is lacking? The answer to this question can be revealed beautifully by your microscope. Go into the woods and find a gray-green lichen that is growing on a rock or tree trunk. Break it off and take it to your microscope laboratory. With scalpel or razor blade, cut sections from the piece. Lay some of these on a microscope slide, add a drop of water, and tear them into small particles with dissecting needles. Add a cover glass. Now look at the pieces through your microscope, at a magnification of at least 100 diameters.

You will see a tangled mass of white or colorless threads among which are scattered pieces of bright green material. Closer examination reveals that these green bits have a definite structure. They may form threads or masses of round or elongated cells, whose granules or disks of green chlorophyll will be revealed by higher magnification.

Here, then, is the answer to the question of how the lichen can live. The green bodies are cells of an alga, while the colorless strands are parts of a fungus. The alga may be of the same type as that you have seen growing as a green mass on the surface of a pond, or creeping over the outside of a flower pot. The fungus is a relative of the mushrooms you had for dinner.

A fungus, lacking green chlorophyll which would enable it to manufacture life-giving starch from sunlight and air and water, must absorb its food ready-made. That is why molds and toad-stools always are found growing on decaying wood or other materials from which they can absorb ready-made food. The fungus part of the lichen has to get its food second-hand, but instead of selecting a mass of decaying leaves for its home, it has persuaded the chlorophyll-containing algae to join with it in setting up a novel kind of plant partnership.

The alga-fungus organization has worked out a production schedule so satisfactory that no labor troubles ever arise, so long as moisture and light and air are available. The alga manufactures starch for itself and the fungus, from air, sunlight, and water. The fungus, which has to depend entirely on the alga for its meals, does its share of the work by providing protection to the alga and by absorbing moisture from the air

Strange Partnership of Fungi and Algae for Mutual Benefit

By Morton C. Walling

A tiny toadstool found in the field or a mushroom from the grocery store, will provide hours of fascinating entertainment with a microscope

The lichen, therefore, is a partnership of green algae embedded in the grayish strands of a fungus plant. The brighter green of a wet lichen is caused by the fact that the protective layer of fungus strands is more nearly transparent when wet than when dry. The power of the fungus to absorb water from the surrounding air is amazing. It can live in places too dry for any other vegetation. Even after being kept in a dry state for years, some lichens are said to become completely revived in a short time, if placed in water or a moist atmosphere.

For a better understanding of the lichen, you can make a microscopic exploration of fungi and algae. The fungi world is so extensive that no more than a few high spots can be considered here, and the algae must, for the time being, be left out entirely. However, you will not want for microscope material, for even a single mushroom or toadstool will provide hours of fascinating entertainment.

The common mushroom, that you have seen growing in fields and woods and on rotting logs, is a plant, but it differs so much from the general idea of plants that it is of extraordinary interest. More accurately speaking, the mushroom itself, the part of it with which the average person is familiar, is but a portion of a plant. It is the visible outcropping of a subterranean network, hidden in the soil or within the decaying mass.

This underground network, called the mycelium or spawn, is a system of cells whose function is to gather food from the medium in which it is growing. It grows usually in leaf-mold, decaying wood, and such places because of the great amount of ready-made food to be found there. Under the microscope the mycelium looks somewhat like a root system, and is made up of colorless strands with hairlike threads or branches.

The mycelium of the common mushroom lives entirely underground, just beneath the surface. Careful examination of almost any particle of rich soil or rotting leaves will reveal it. Simply place the particle in a test tube or bottle of water and shake it vigorously, to wash away foreign matter. The mycelium fibers can be separated in a mass with tweezers. Perhaps an easier method is to find a mushroom, dig it up with a spoon so that part of the soil beneath it is obtained, and then wash the dirt away from the rootlike mycelium without bruising it.

The mycelium is a plant in itself, but because the local food supply may not last forever, it has to send out spores that will start new colonies of fungi in other localities. To do this, it produces fruiting bodies. These are the mushrooms you know. They spring up overnight at various points in the mycelium network. The process involves a sort of gathering of mycelium strands into knots which grow and merge into the stem and cap of a fruiting body that frequently is parasol-shaped.

Examine a common mushroom. You will find that it has a stem surmounted by an umbrella-shaped cap. Around the stem is a ring of membranous tissue. Over the cap is a layer of similar tissue, which may extend as a ragged layer at the edges. The underside of the cap is lined with a system of gills, which are plates that radiate like the spokes of a wheel. The ring around the stem was formed during the growth of the mushroom by the breaking of the protective membrane that was stretched over the entire structure when it burst through the ground.

You will find it interesting to examine the entire structure of a mushroom with your microscope. With a sharp knife, cut thin slices from the stem and cap, and mount them in water on slides. You can employ various microscopic stains to bring out the structures of the cells. You will, however, fail to find any of the

(Continued on page 93)

The octopuslike object in the center of the page is a formation of mycelium strands in a lichen. The photographs above show successive steps in making paraffin cells for temporary slides. A thin candle is molded in a piece of pipe which is removed by heating it gently and lifting the wick. The cell is spun by holding a hot candle end against the glass

HOMEMADE CAR RUNS FIFTY MILES ON GALLON OF GAS

This homemade car costing $20, has forty-five-mile speed and runs fifty miles on gallon of gas

When car owners boast of their engine's low fuel consumption, young Jack Berg, of Akron, Ohio, can put them in their place, for his midget automobile, he claims, travels fifty-two miles on a gallon of gas. Built by an Akron engineer at a cost of only twenty dollars, the tiny two-seater machine is said to attain a speed of forty-five miles an hour, under the power of an old motor-cycle engine installed at the rear. A kick starter sets the engine running, and foot pedals in the driver's compartment provide a clutch, an accelerator, and a brake, while gears are shifted with a hand lever. Tires of doughnut type are used

View in circle shows kick starter of midget car

PAVE STREET WITH RUG TO TEST ITS ENDURANCE

Paving a city street with household floor covering was the unusual means chosen by a Tulsa, Okla., department store to advertise the wearing quality of its merchandise. For the odd demonstration, the maker supplied a piece of material 226 feet long and nine feet wide, containing sufficient material to cover twenty kitchen floors, and said to be the largest rug ever manufactured in the United States. When laid on one of the main business streets, it extended for a substantial part of two city blocks. Cars rolled over it for two weeks, giving it more usage than such a rug would be likely to receive in many years

BATS FEED ON FISH

A strange colony of bats, which exists only in the Gulf of California, feeds upon fish. Recent examination of the bats' stomachs has disclosed remnants of small fish. How the fish are caught has not yet been determined.

POCKET METER TO TEST LIGHT IN YOUR HOME

With the aid of a new pocket illumination meter, anyone may determine for himself whether the light from electric lamps in his home or office is sufficient for his needs. All the user need do is to draw out a slide, uncovering a disk of pale yellow, light-sensitive paper in a circular window, and expose it for two and a half minutes at the spot where he sits or works. At the end of this time, if the sensitized paper has darkened to a deeper tint than the buff color of the envelope itself, the illumination is rated as good; while if the disk appears the lighter of the two, the light is bad. Additional tests are made by withdrawing the slide farther each time and exposing the ten disks of paper in turn.

GAUGE SHOWS RIPENESS OF SUGAR CANE

So planters may harvest sugar cane at the moment it reaches perfect ripeness, a German optical maker has developed an amazing new instrument called a refractometer that measures ripeness with absolute accuracy. The instrument resembles a small telescope except for the wedgelike end, which contains a prism covered by a hinged lid. Cane juice to be tested is dropped on the lid, which is then closed. When the device is held to the light and focused, the tester sees a circular field marked by a scale. Light passing through the sample of juice is refracted in proportion to the sugar and other solids contained in the fluid, darkening a corresponding portion of the field.

New meter which shows ripeness of sugar cane is seen in use above. The result is read in a shadow that falls on a dial. At left sugar cane gauge and sampling instruments. The hand is holding gauge for tomatoes

STAMPS PORTRAY THE NEXT WAR

The stamp at the left depicts an air raid on a city, while the one at the right shows refugees fleeing

Horrors of the next war are graphically depicted in a set of postage stamps just issued by the Soviet government, which are believed the first of their kind ever printed. While announced simply as marking the twentieth anniversary of the World War, their appearance has aroused speculation as to whether they may constitute propaganda deliberately directed at militarism in other lands. The five-kopeck stamp, for example, portrays a skyline to be found nowhere but in the United States. It shows bombs raining down upon a defenceless metropolis from air raiders hidden in the clouds pictorially expressing the view of many military experts that non-combatants as well as fighting forces will be marked for slaughter in future conflicts. The ten-kopeck stamp pictures the flight of the civil population to the open country, away from the charnel houses of the cities. Others in the set show an allegorical figure of a modern war god destroying a city; soldiers in fine physical condition, marching to the front contrasted with returning cripples and the final revolt of the opposed armies in mutual protest against the destruction of their families, as symbolized by a pair of former enemies grasping hands and trampling underfoot a military figure

ODD WHISTLE TESTS BROADCAST HOOKUP

A curious device known as a Galton whistle, which can emit a peep inaudible to human ears, helps maintain the quality of radio programs broadcast by a New York station. By turning a knurled knob at the top of the device, its pitch may gradually be raised until it passes beyond the range of audibility. Using this device as shown in the photo, a radio engineer can determine whether any given type of microphone or circuit is sufficiently responsive to extremely high-pitched tones to meet the needs of broadcasting.

The Galton whistle in use for testing a crystal microphone of recent design

This automatic device starts the engine of a parked automobile whenever the temperature gets low, and keeps it running long enough to warm up for use

Auxiliary wheels, set at the proper height and angle, keep this Austrian motor cycle from tipping too far

MOTOR CYCLE CANNOT FALL OVER

Even when it is tipped to the angle shown in the photograph above, a safety motor cycle recently demonstrated in Vienna, Austria, does not fall over. A spill in either direction is prevented by a pair of wheels mounted on either side of the regular rear wheel, and set so that they come into play when the machine tilts.

THIS KEY WON'T BE FORGOTTEN

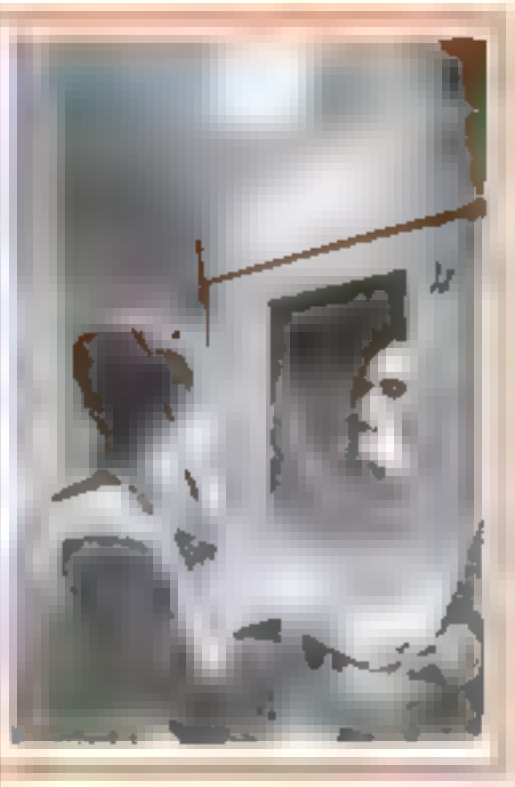
A factory superintendent at Columbus, Ohio, has invented a car key that reminds its owner to take it along. When the ignition is turned off, a spring on the shank of the key ejects it into the owner's hand

ROBOT RUNS ENGINE TO WARM IT

No matter how cold the weather, a parked car equipped with a new accessory is always ready for instant starting. To keep the machine warm, this robot automatically starts the motor whenever the radiator temperature falls below 120 degrees, shutting the motor off again when it has warmed up. The equipment includes a thermostatic control box that is installed under the hood, a switch on the instrument board to disconnect the robot when its operation is not desired, and a safety cut-out switch that prevents the device from operating if the car is inadvertently left in gear. There is also an automatic cut-out that prevents running down the battery if the motor fails to start for lack of fuel or any other reason.

NEW IDEAS OF INTEREST TO HOMEMAKERS

LAMPS BUILT INTO CHAIR. A pair of lamps set in the wings of this chair provide perfect light for reading. Photo at left shows method of metal arm and one of the bulbs set behind its pane of frosted glass

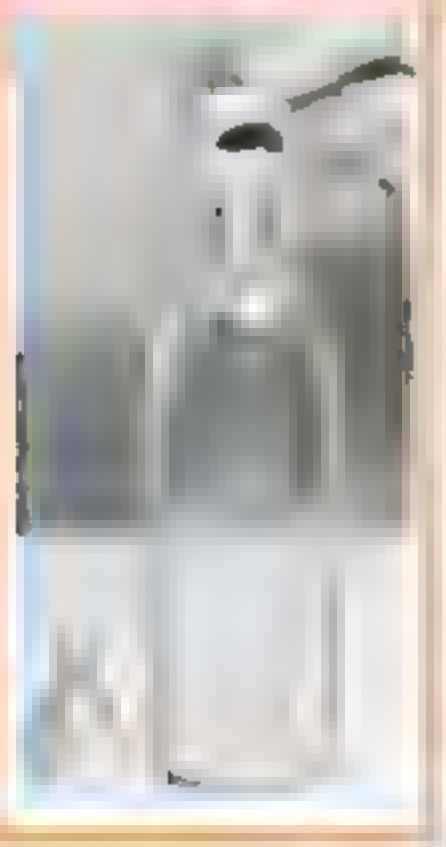


REFLECTORS FOR SHAVING. A pair of reflectors placed on either side of the bathroom mirror as shown at the left, catch light from the lamp overhead and reflect it to the sides of the face and under the chin. The same arrangement may be used on a lady's dressing table. Below, one of the adjustable reflector units

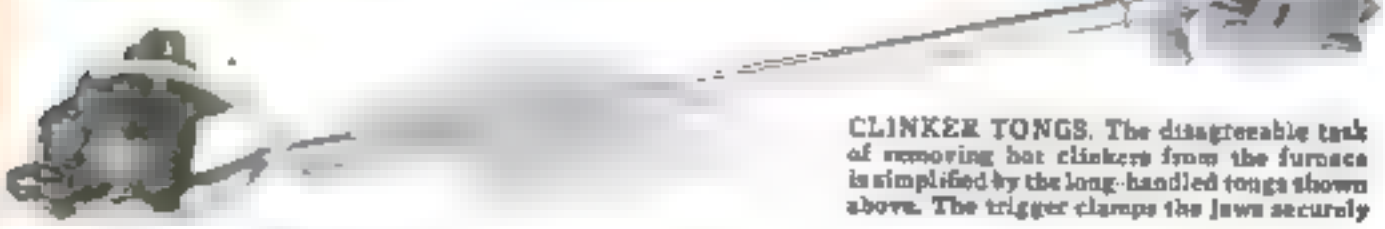
SOFTENS HARD WATER. This filtering device, which can be attached to any faucet by adjusting the chain, is said to soften any hard water run through it. It can be used indefinitely if the filtering material is regenerated

NIPPLE SCREWS ON. Breaking of nursing bottles as nipples change nipples over the caps, is eliminated by the screw-on nipple shown below. It can be put on in the dark and fingers need not touch the nursing surface. Another advantage is that it won't pull off, as ordinary nipples do

ROBOTS CONVERSATION



The artist's knocker above conceals a small electric bulb that lights up automatically when the knocker is lifted, illuminating the keyhole



CLINKER TONGS. The disagreeable task of removing hot clinkers from the furnace is simplified by the long-handled tongs shown above. The trigger clamps the jaws securely

PAPER HOLDS COFFEE GROUNDS. With this paper liner in the perforated coffee basket of a percolator the grounds can be dumped out easily without the usual mess. The paper also serves to filter the coffee, making it clearer

NEW-STYLE COOKY CUTTER The automatic handle on the novel cooky cutter at left measures the dough, forms it, and cuts it off. The device operates like a pump, forcing the soft dough through the perforated molding disk at the lower end. The cutter comes all apart for cleaning

HANDY RACK The versatile rack pictured above can be slipped on the back of a chair for drying towels or light clothing. It may also be used as a tie or towel rack, or fastened to a shelf to support garment hangers

BEAN SLICER The handy little knife below is used for slicing string beans or opening peas or lima bean pods. It clamps firmly to a table or bread board. String beans sliced with it take less time to cook, and the strings are cut up

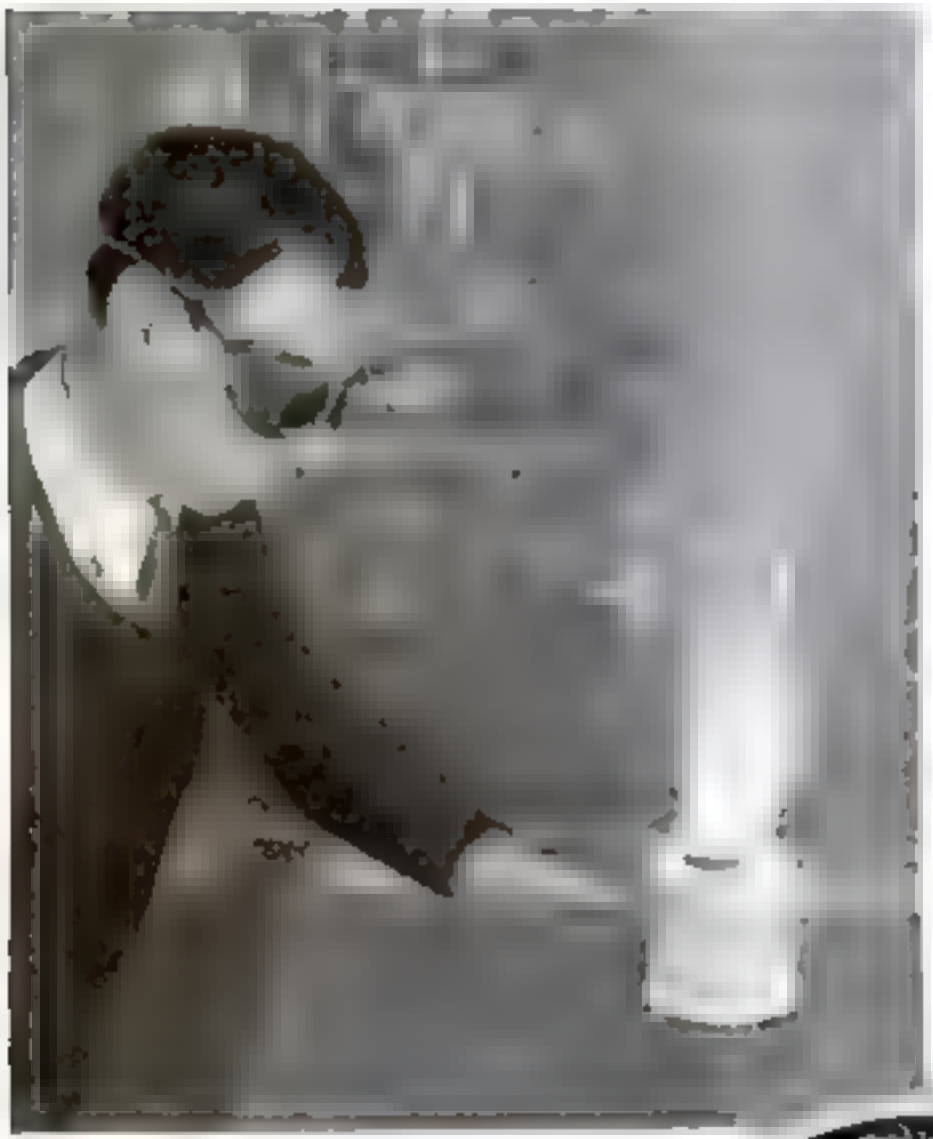
CORNER SHIELDS AID IN CLEANING Star-shaped little shields of spring metal shown at left, are easily pressed on to corners on staircases and elsewhere. Preserving a rounded surface they do away with corners and make cleaning easy. Lower picture shows size of shield

ICE-CUBE TONGS A dainty way to serve ice cubes is provided by the tiny tongs shown below. Pressing the thumb plunger opens the spring jaws to pick up a cube or drop it gently into the glass

SAFETY BATH GRIP The danger of falling while getting into or out of the bath tub is reduced by this safety grip. It has an interior of flexing so that it will hold any shape and the suction cups on the under side keep it firmly in place. The cups are seen in the photograph reproduced at the right

POT KEEPS COFFEE WARM. Double walls in the new coffee pot at the right provide insulation which keeps the contents warm until served. Any hot beverage will retain its heat in this pot for two or three hours, according to the manufacturers

CHEMICAL STUNTS *with*



By

Raymond B. Wailes

FEW metals are more spectacular chemically than chromium and manganese. Miniature lava-spitting volcanoes, mysterious color changing chemicals, and midget war-time smoke bombs are just a few of the possibilities they offer the home experimenter.

Even the production of the free metals provides a thrilling effect. A temperature ranging between 2,000 and 3,000 degrees Centigrade must be used to break them away from their compounds. In the home laboratory as well as commercially this is obtained with the aid of oxygen-loving aluminum in the spectacular thermit process.

In our experiments with iron (P. S. M., Aug. '33, p. 50), we used the thermit process to free iron from iron oxide. In the present experiments we will use a thermit mixture to free chromium from chromic oxide and manganese from manganese dioxide.

All that is required for the home manufacture of metallic chromium are a sand or porcelain crucible firing pot, some form of insulating material to prevent heat losses, a small quantity of aluminum powder, potassium perchlorate or magnesium powder, and some chromic oxide (green) to serve as the source of chromium. The chemicals should be mixed in the proportions of fifty parts by weight of chromic oxide to twenty parts of aluminum. Although not absolutely necessary, fifteen parts of potassium bichromate, which has been melted and allowed to cool, also can be added if it is handy. When this addition is made, however, five parts more of the aluminum powder also should be included.

When thoroughly mixed, the thermit charge should be dumped into the crucible and a small depression made in the top to take a half-and-half mixture of potassium perchlorate and aluminum or a small pile of magnesium powder. These chemicals serve merely as a priming mixture to start the process and do not enter into the reaction.

To conserve the heat, the crucible should be insulated. One effective method is to embed it in powdered fluorspar. Another, and perhaps simpler way, is to rest it in the open end of a short length of ordinary pipe insulation.

Finally, ignite the starting mixture of magnesium or potassium perchlorate and aluminum. This will immediately raise the temperature and soon the contents of the crucible will be a glowing mass. Because of the vivid white flame given off as the aluminum steals the oxygen from the chromic oxide to give free chromium, the reaction should be watched only when the eyes are protected with colored goggles.

METALLIC CHROMIUM

How the home chemist can prepare metallic chromium is shown in the illustration at left. The crucible in use must be well insulated as a temperature up to 3,000 degrees occurs during the experiment.

With a small fire pot of about fifty cubic centimeters capacity, the process should continue vigorously for fully a minute. When it cools, the chromium set free by the aluminum, and melted by the extremely high temperature, will be embedded as a lump in the ash at the bottom of the crucible. If a porcelain crucible was used, it usually will crack of its own accord and simplify the problem of reclaiming the chromium. If a sand crucible has been used, it can be shattered with a hammer.

Although the metal obtained will not be absolutely pure, small pieces broken from the lump will be unmistakably metallic. Dropped into dilute nitric acid they will dissolve. Once placed in strong nitric acid, however, they exhibit a peculiar passive effect in that they then will be insoluble in the weak acid until the passive surface is broken either by rubbing or scratching.

Bits of chromium also will produce a novel effect when dropped into a shallow container of molten potassium nitrate or potassium chlorate. Like the metal sodium on water, it will float and

A tiny volcano, produced in the home laboratory is shown in the circle. At right, the manner of arranging and firing the volcano to give the lifelike eruption is shown.

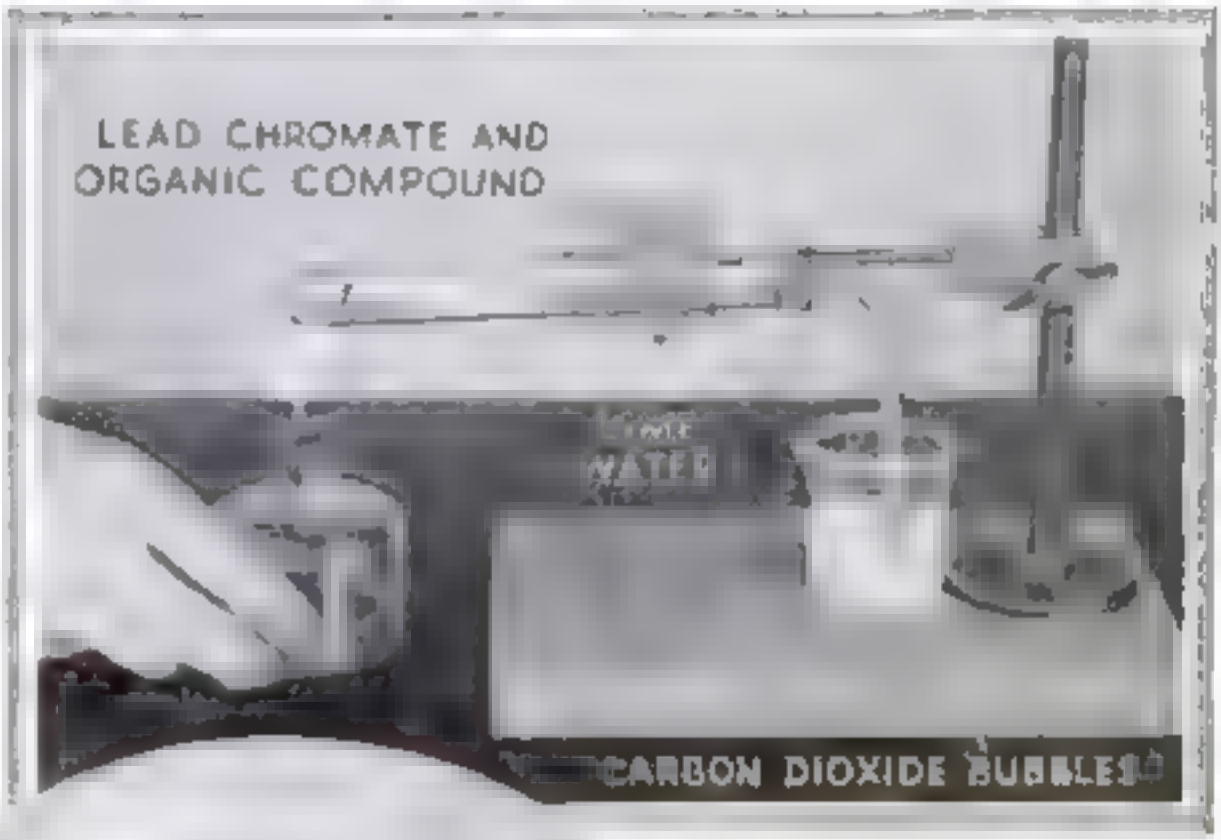
Chromium *and* Manganese

skid around the surface of the molten mass with curious scintillations. The nitrate or chlorate can be heated in the cup of a tin can held over the flame of a laboratory gas burner

Metallic manganese can be made by the same method used to prepare the chromium. In this case, however, manganese dioxide, which has been heated red-hot, is mixed with the aluminum powder instead of the chromic oxide. The potassium chromate also is eliminated. Simply mix three parts of the manganese dioxide with one part of aluminum powder, place it in the crucible, prepare the ignition mixture and touch it off

In the various oxides of chromium, the amateur chemist will find many interesting substances. One in particular, chromium trioxide, takes the form of woolly red crystals. To make a small quantity simply add strong (concentrated) sulphuric acid to a strong water solution of potassium bichromate. Although the red crystals which form cannot be filtered off with ordinary filter paper they can be removed from the solution with a filter made by packing glass wool into an ordinary glass funnel. Before removing the crystals from the glass wool, wash them thoroughly with strong nitric acid to remove the sulphuric acid.

When brought in contact with such organic substances as absolute alcohol (alcohol which does not contain the usual four to six percent of water), these red chromium trioxide crystals immediately oxidize it, causing it to burn with a flash of flame. Even coal will be oxidized by the crystals. Powdered coal, placed in a test tube and treated with a solution of potassium bichromate dissolved in fairly strong sulphuric acid effervesces to give off quantities of carbon dioxide gas. In both of these experiments, the large amount of oxygen available in the chromium trioxide is responsible for the reaction.



Because ammonium bichromate, another red chromium compound, decomposes actively with a hissing noise to give large quantities of green ash, it forms the basis of a particularly novel home-laboratory experiment. With it the home chemist can produce a miniature active volcano.

To enhance the effect, a tiny volcanic mountain can be fashioned from a small amount of plaster of Paris. At the top, a small hole formed in the plaster should then be filled with small particles of ammonium bichromate and the chemical ignited with a match. Bright flashes of light will dart from the opening as the volcano becomes "active." Steam will be formed and a green "lava" will bubble from the hole to run sluggishly down the slope of the mountain.

Beside the realistic effect it produces, the experiment also has a practical value. The green material formed by the decomposition of the ammonium bichromate is the self-same chromic oxide used in the preparation of free chromium.

Although it is best to use commercial ammonium bichromate in this experiment, if he desires, the home chemist can manufacture his own by neutralizing ammonium hydroxide with the red, wooly crystals of chromium trioxide (chromic acid), crystallizing it from the resulting solution.

Ammonium bichromate also can be used as the basis of an interesting light-sensitive compound. Make a thin glue solution and dissolve in it some ammonium bichromate (potassium bichromate also will serve). Into this rub a pinch of lampblack and brush the mixture onto a piece of cardboard as you would a coat of paint. Finally after the sample has been allowed to dry, place a camera negative or a cut-out figure of some sort over the treated surface *(Continued on page 107)*

You Can Make Your Own Filter Paper

Since filter paper costs money and is sometimes hard to obtain, you can save time and cash by making your own as illustrated below. The necessary circles are cut of the required size from paper towels, which make good filters

INDOOR CLOCK STRIKES TOWER CHIMES

Cabinet for set of small chimes resembles grandfather's clock

WITH an ingenious auxiliary timepiece developed by a New York sound-device man, a larger clock in a public building or outdoor advertising display can be made to strike the quarter hours without installing an expensive set of chimes. The small clock is operated by a self starting synchronous electric motor and contains four tubular chimes. When the chimes are struck, a microphone picks up the sound. This is amplified by a unit in the base of the timepiece and transmitted by wire to a loud-speaker hidden in or near the large clock. The amplified sound is said to be as fine as that of a set of chimes costing thousands of dollars. Failure on account of current interruptions is prevented by an auxiliary spring in the striking mechanism. Although the auxiliary clock loses time while the current is off, the spring compensates for the loss and the chimes continue to sound at the proper intervals, regardless of how fast or how slow is the time shown by the clock.

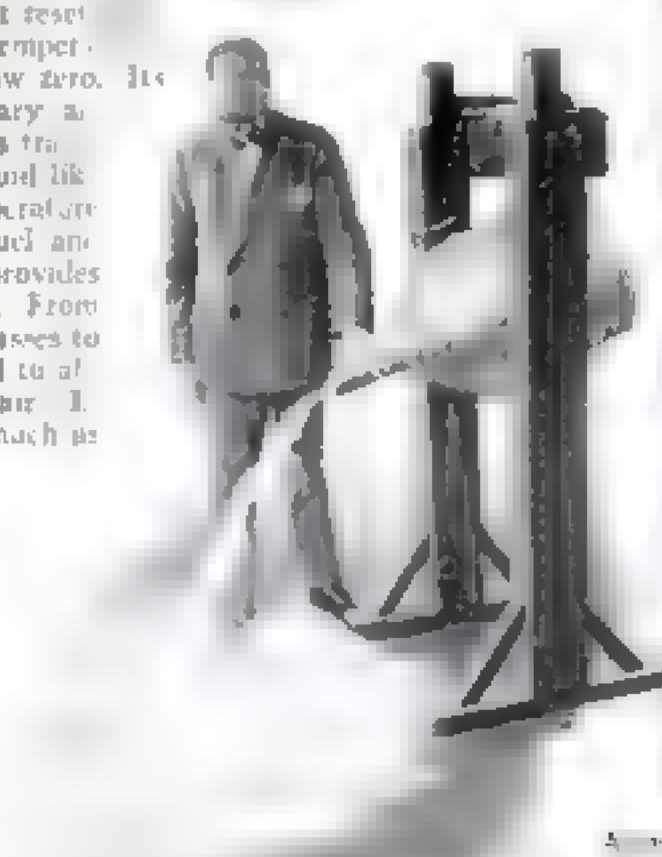
Sound of chimes for outdoor clock is picked up by a microphone suspended inside timepiece

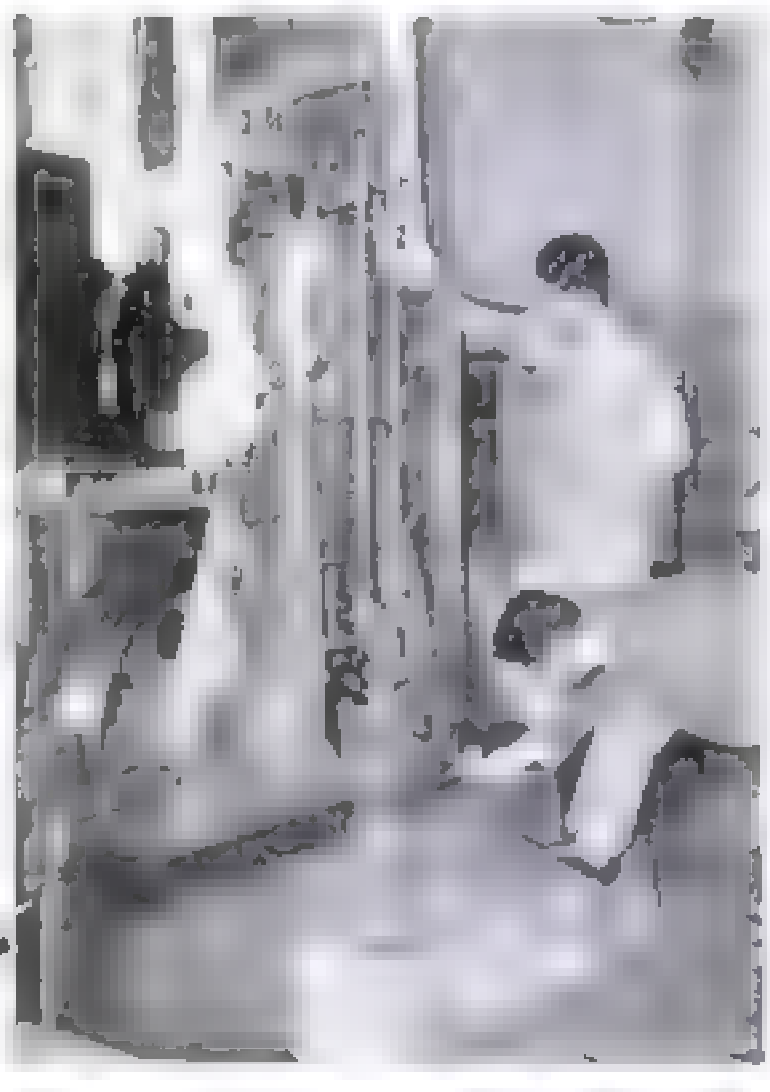
MUSIC BY ROBOT INSECTS

GROTESQUE manikins, patterned after insects and apparently endowed with musical ability are the creation of a Los Angeles, Calif., engineer. Hidden electric motors actuate the six-foot grasshopper and the cricket shown in the illustration, making them appear to be playing upon the harp and violin. A concealed phonograph emits strains of music corresponding to the tones of real instruments and timed to match the movements of the odd figures. The photograph above shows the designer applying a finishing touch of color to one of the manikins before putting it through its paces.

LIQUID AIR USED AS FUEL BY REMARKABLE JAPANESE ENGINE

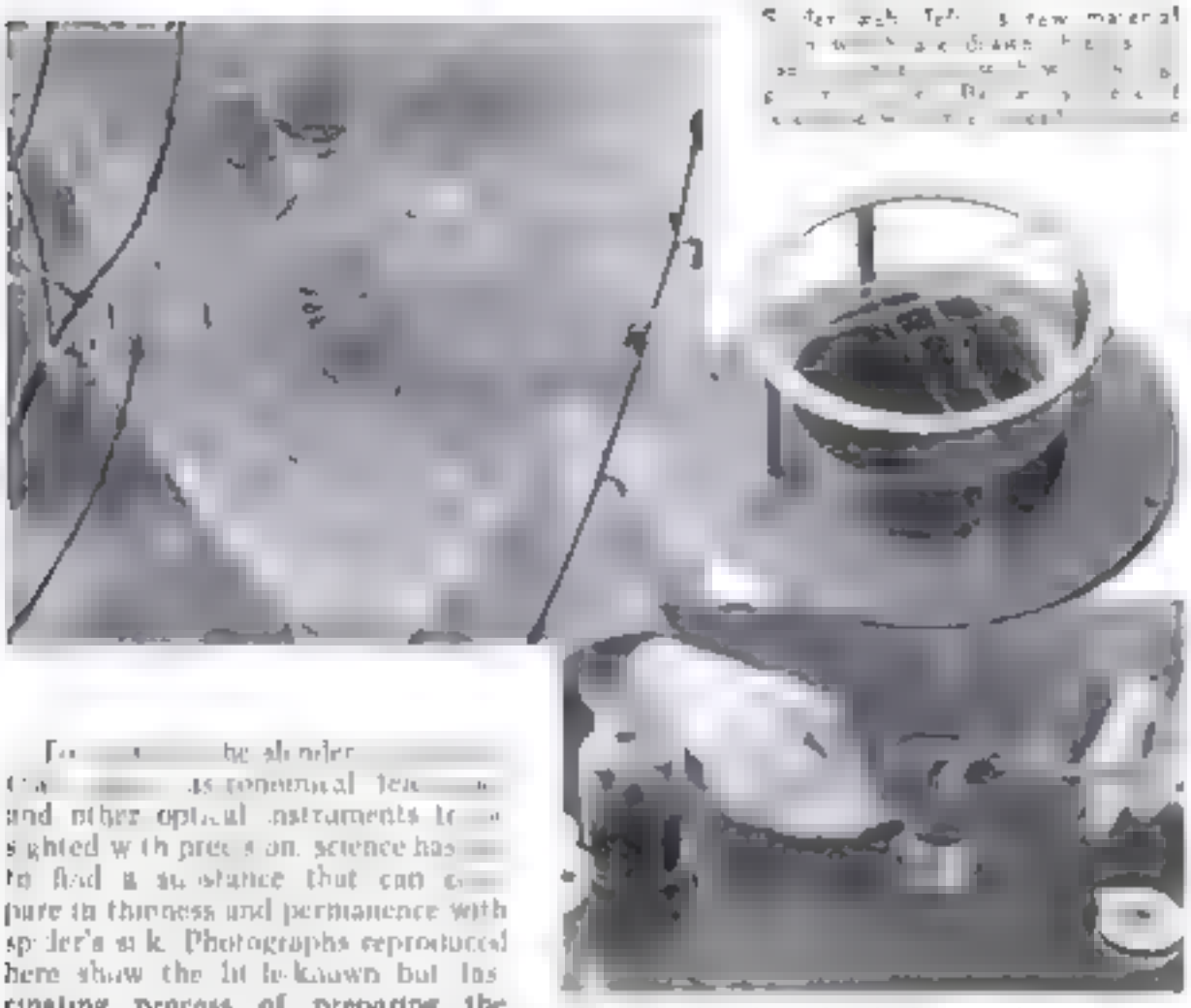
LIQUID air serves as fuel for one of the strangest motors ever built, which now is operating in a Japanese laboratory. Should it fulfill the hopes of its [illegible] it may bring about a revolution in motive power for vehicles of the land, sea and air. In contrast with the fiery temperatures of a conventional internal-combustion engine, which it somewhat resembles, the new motor operates at temperatures from 250 to 350 degrees below zero. Its small fuel tank holds ordinary air that has been chilled until it is transformed from a gas into a liquid like water. The difference in temperature between this extraordinary fuel and the surrounding atmosphere provides the energy to run the motor. From the fuel tank, the liquid air passes to a chamber where it is allowed to absorb heat from the exterior air. In doing so, it turns to vapor, much as water turns to steam when heated in a boiler. The pressure of the expanding air drives pistons in a pair of cylinders. Through an elaborate system of auxiliary apparatus, virtually all the energy contained in the liquid air is reported to be recovered. Because of its efficiency and small bulk of fuel required the [illegible] eventual application of his [illegible] planes. The [illegible] fuel [illegible]





[illegible]

HOW SPIDER WEB IS PUT IN TELESCOPES



A weighted spider web is laid across the eyepiece as above and fastened in place with drops of varnish

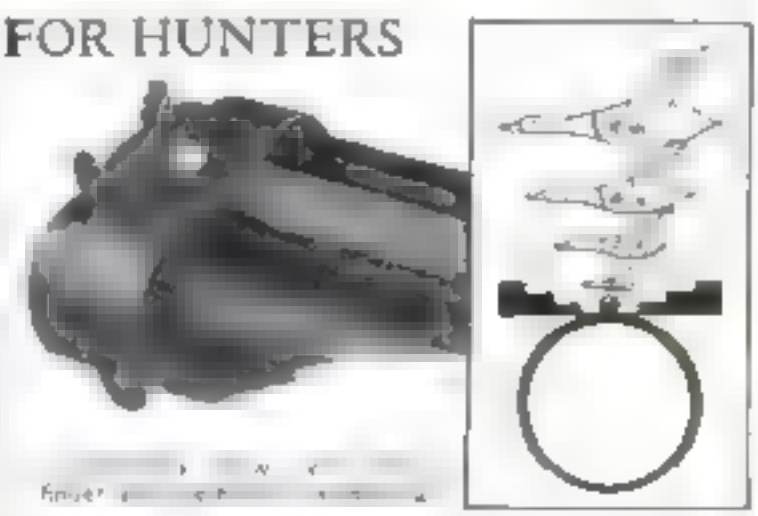
[illegible] the slender [illegible] as reticules for telescopes and other optical instruments to be sighted with precision, science has come to find a substance that can compare in thinness and permanence with spider's silk. Photographs reproduced here show the little-known but fascinating process of preparing the threads from spider webs, as it is carried out in one of the world's largest optical houses. A needle with a bent tip, a pair of tweezers, and a magnifying lens are the only tools employed by the skilled craftsmen who perform this delicate task. The first step is to draw out a single strand of silk from the spider web, and to weight each end with small balls of wax. Hung up to dry for twelve to fifteen hours, the thread shrinks to a fraction of its former diameter. Next it is cleaned with ether, smoothed, and restretched. With these preparations completed, the weighted thread is hung across the eyepiece of the telescope, and secured at each side of the rim by a dab of colorless varnish. Superfluous parts of the thread, with their weights, are cut off and removed as soon as the varnish has dried. Additional cross-lines are similarly applied until the desired pattern has been built up, depending on the type of instrument for which it is made

FACTORY FIRE ESCAPE IS "SLIDE FOR LIFE"

Close-up view of sliding loop used in new fire escape

RIVALING the "slide for life" of a circus aerialist, one of the strangest of fire escapes enables workmen in a Canadian refinery to save themselves in case a sudden conflagration traps them on top of a tower. An inclined cable has been rigged from the top of this structure to the ground, and from it has been hung a traveling loop capable of supporting a man's weight. If fire occurs, a workman on the tower thrusts one leg through the loop and whizzes to earth, checking his precipitate descent with a hand brake. As soon as he steps free from the loop, a counterweight returns it to the top of the tower for the next passenger and the process continues until all are in safety.

RANGE FINDER FOR HUNTERS



BY INSTANTLY giving a duck hunter the range of his target, a new attachment for a shotgun is said to improve the shooting of a novice. This simple form of range finder consists of a sight with a series of notches of graduated width, which is clipped to the end of the gun's muzzle. To find the range of a duck on the wing, the hunter need merely observe which of the notches matches the apparent length of the bird. The smallest notch shows a range of sixty yards, and the other two indicate a fifty-yard and forty-yard range, respectively, while the entire width of the special sight shows a range of thirty yards. Knowing the range, the hunter estimates the bird's speed of flight by a method devised by the inventor

BIRD LEADS GLIDER

THAT air pilots can still learn from the birds was recently demonstrated in South America. By trailing a buzzard near Rio de Janero, Brazil, Peter Riedel, a member of a German gliding expedition investigating the air currents of South America, was able to attain an altitude of 7,000 feet in his motorless craft

COLORED LIGHTS SHOW SPEED OF AUTOMOBILE

COLORED lights reveal at what speed a car is traveling, in a new safety signal devised by a Schenectady N. Y. inventor. When the car is moving slowly forward, a red light shows to the rear. As the speed increases to twenty-five miles an hour, the light automatically changes to blue. At thirty-five miles an hour the signal becomes yellow; and, above forty-five miles an hour, green. Thus the inventor aims to reduce accidents in passing another car, particularly at night when the speed of the overtaken vehicle is difficult to estimate by ordinary methods.

Light mounted at rear of car shows different colors to indicate speed at which it is going

SEAPLANE'S HULL RESEMBLES A SHIP

SUBMARINE, cutter, hydro-glider—what would you guess the strange craft shown in the accompanying photograph to be? Actually it is the hull of one of the world's largest flying boats, now under construction in a French factory. When completed the machine will have accomodations for eighty persons on its two decks, and will have a cruising range of 2,800 miles between stops for fuel. Six water-cooled motors of 1,000 horsepower apiece will drive it at a speed estimated to reach as high as 160 miles an hour. The giant ship is to be placed in transatlantic service on the French air line between Paris and Buenos Aires, Argentina. Originally this line carried only air mail, and fast dispatch boats plied the over-water part of the route between Africa and South America. Recently transatlantic mail planes were put in service, enabling the mail to be flown all the way. The new air giant will permit passengers to be carried as well. It is expected to be ready for service in June, when the new service is scheduled for inauguration.

RACK HOLDS TELEPHONE MESSAGES IN VIEW

A HEMPSTEAD, N. Y., business man has devised a handy desk accessory to keep telephone messages from being mislaid or overlooked. The base of this device serves as an ash tray, while a detachable message rack is provided with a pencil for jotting down messages and a clip for holding them. Removed from its base and rested upon the telephone, it confronts the user, upon his return, with all the messages received while he was gone. At other times it serves as a decorative ornament for the ash tray.

"BREAKS IN" NEW PIPES

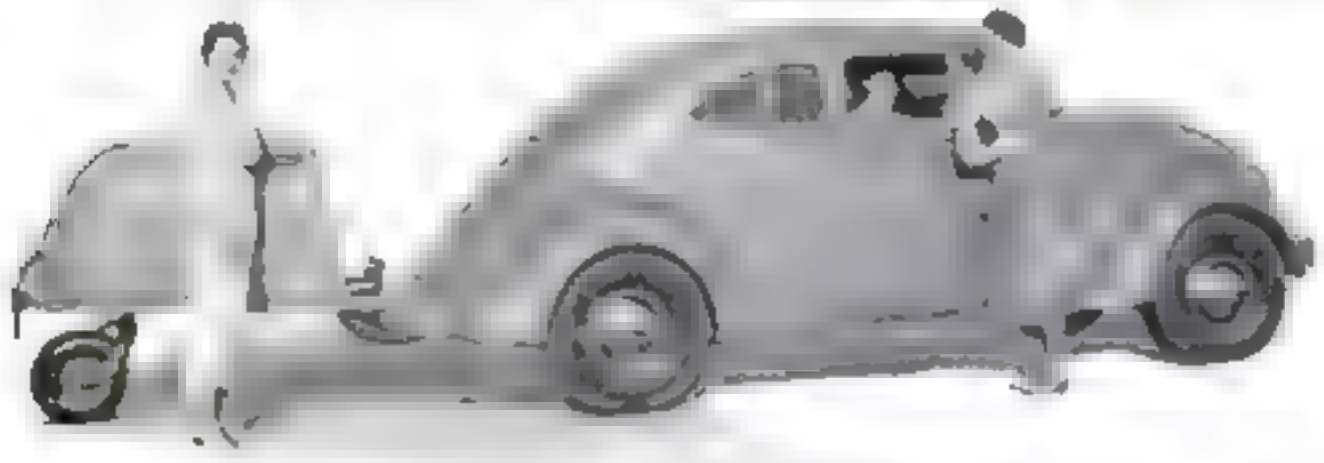
A LITTLE robot that shoulders the task of "breaking in" a new pipe is now available. When the pipe is lighted, its mouthpiece is thrust into a section of tubing, and a rubber ball is squeezed occasionally. The smoke is exhaled through a slit in the ball. After an ounce or two of tobacco has been consumed, according to the maker, the pipe is ready for smoking, free from the biting taste of varnish.

COP CAMERAMEN GET PICTURES OF WRECKS

SO OFTEN have photographs fixed responsibility for car crashes that the Chicago police have established a permanent camera squad to snap pictures of accidents. Twelve cars equipped with cameras, first aid kits, and brake testers, cruise the city, listening for radio calls from headquarters. When a traffic smash is reported, the cars rush to the scene and photograph all angles. Thus, impartial evidence is obtained for use in criminal and civil cases. The photographs will also be of value in safety-campaign work for the education of drivers.

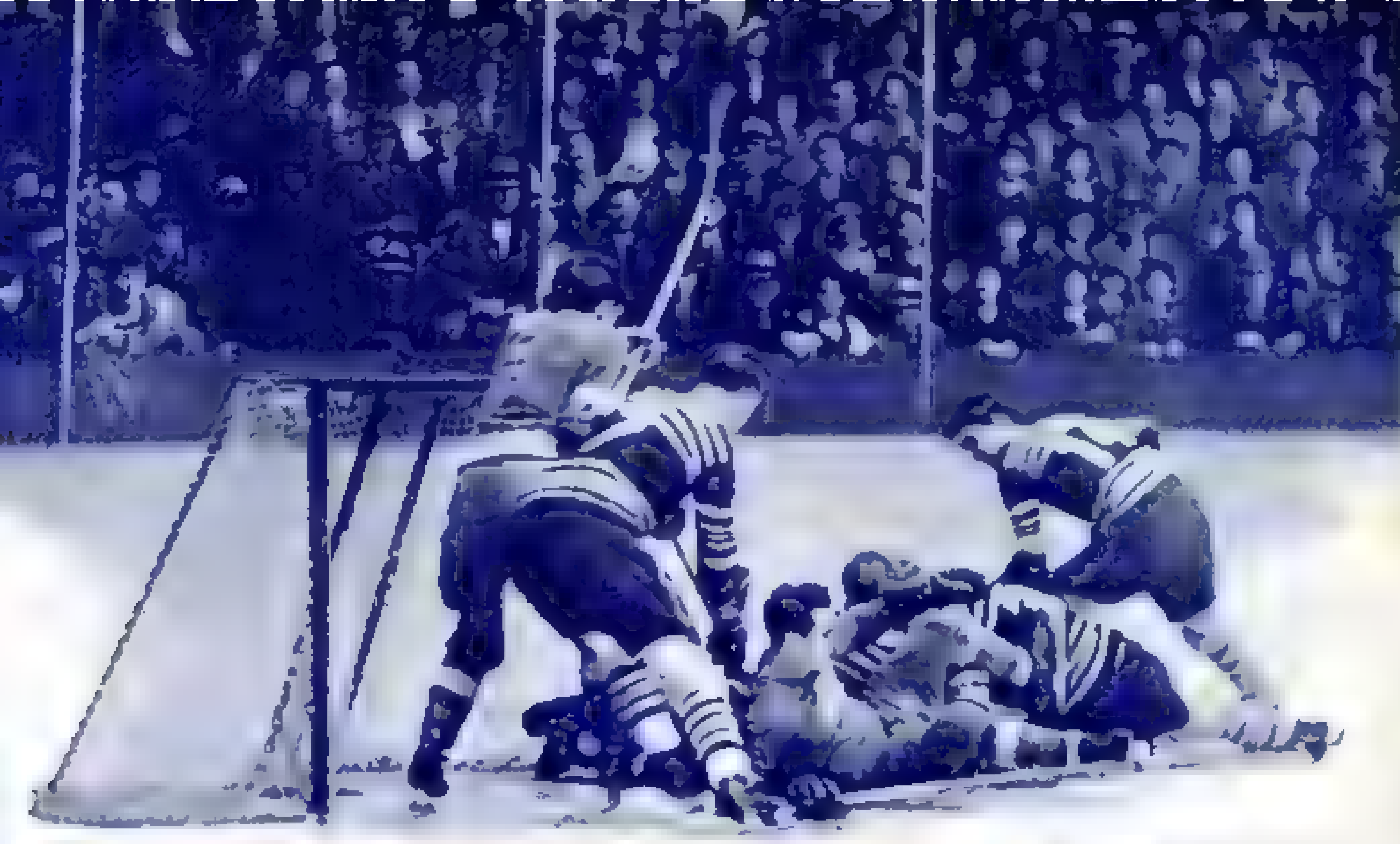
Chicago policemen photographing the scene of a crash

STREAMLINE AUTO TRAILER HAS SINGLE SWIVEL WHEEL



New streamline auto trailer for carrying luggage. Note the single swiveled wheel that supports it

MODERN streamline ideas have been applied to a new one-wheel automobile trailer for carrying luggage. The trailer consists of a rounded hood fitted over a steel frame which is attached to the frame of the automobile by hinge-like couplings. A lid at the rear gives access to the interior. The trailer rides on a single wheel mounted on a swivel, and the tire is a modification of an airplane tail-wheel tire. The caster-like wheel, being free to rotate, adapts itself readily to irregularities of the road. When the car is backed, the swivel turns.



Vast crowds, sitting in comfortably heated rooms, now watch the thrills and spills of ice hockey

Triumph of Science Makes
[illegible]
BIG BUSINESS

By Edwin Teale

BURSTS of speed [illegible] thrills that [illegible] the stands have [illegible] hockey in less than a decade to the position of national winter sport of American fans. It is the [illegible] game of the indoor season.

[illegible] thousand persons [illegible] Madison Square Garden in New York City to see a game between crack professionals. Throughout the country [illegible] are increasing [illegible] the game is [illegible] new fans are being [illegible]. Huge rinks for hockey matches are under construction. Professional teams are playing [illegible] games from coast to coast and [illegible] the season with a nerve-tingling World's Series of the Ice, the annual battle for the Stanley Cup. Perhaps no other sport ever zoomed to such sensational popularity in so short a time.

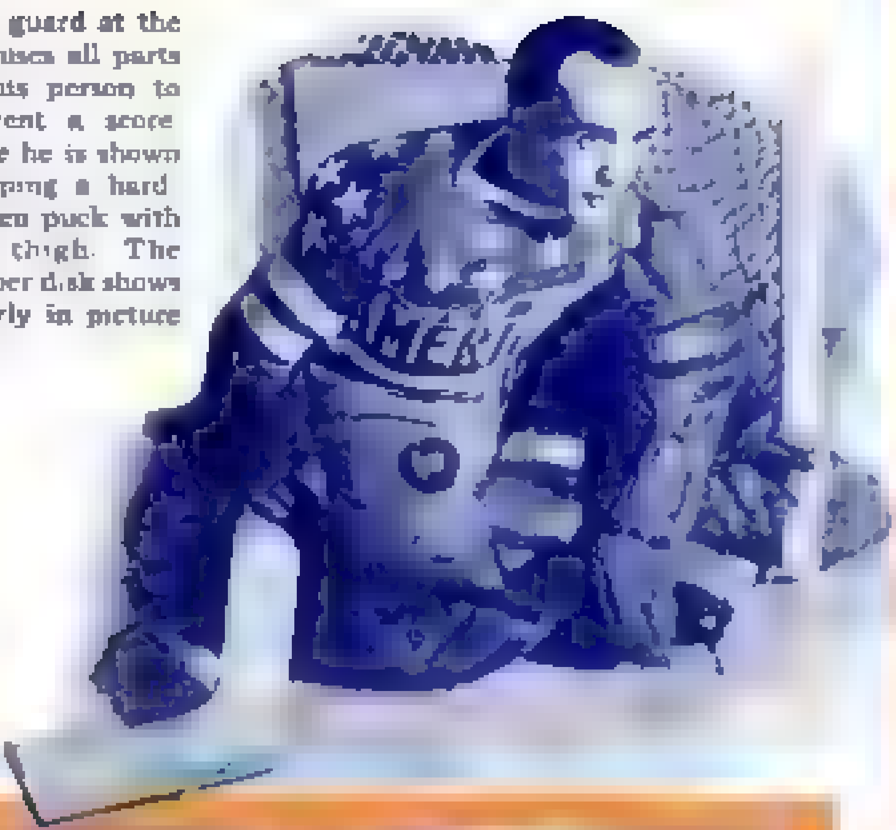
The secret of hockey's appeal is simple. It is the fastest, roughest, hardest-hitting game of the [illegible]. There are [illegible] [illegible] teamwork [illegible] as the [illegible] players zigzag back and forth over the [illegible] following the rubber puck. [illegible]

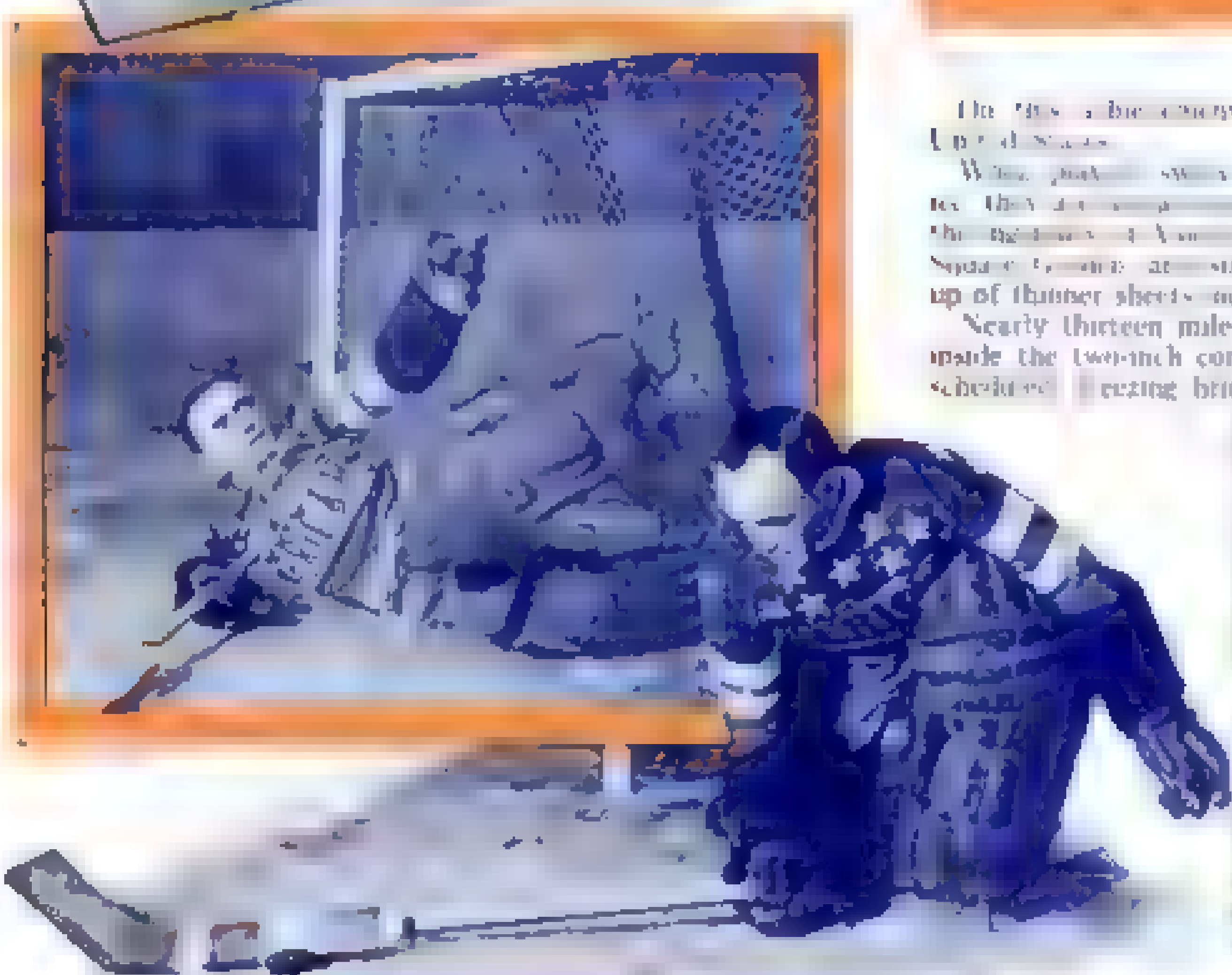
[illegible] enough [illegible] the year 1925 [illegible] hockey on a [illegible]. Only [illegible] the game [illegible] success [illegible] a [illegible] research.

In Canada, where hockey has [illegible] its peak [illegible] of French [illegible] keep [illegible] warm. [illegible] modern [illegible] hockey [illegible] in the same arena.

Left, an exciting moment in a hockey game. A defense man is rushing up to take the puck after goalie has made a save

The guard at the net uses all parts of his person to prevent a score. Here he is shown stopping a hard driven puck with his thigh. The rubber disk shows clearly in picture





[illegible] hockey in the United States.

[illegible] ice. [illegible] foundation provided by [illegible]. At New York's Madison Square Garden [illegible] hockey rinks, that sheet is [illegible] up of thinner sheets [illegible] together like [illegible] wood.

Nearly thirteen miles of pipes run back and forth buried inside the two-inch concrete floor. When a hockey match is scheduled, freezing brine flows through the pipes and a thin sprinkling of water is [illegible] over the [illegible]. As this layer congeals, another [illegible]. In this way an [illegible] than 180 feet [illegible] feet wide is built up [illegible] of an inch. The action of [illegible] with its maze of hidden [illegible] suggests a [illegible] working [illegible].

[illegible] Madison Square Garden [illegible] of piping. During [illegible] between the freez[illegible] and the heating radiators in the stands above [illegible] up and tuck. In fact [illegible] pairs of [illegible] and [illegible]. As the [illegible] the loss was $150 for skates and shoes alone. Additional piping now overcomes [illegible] difficulty and insures against sudden shifts in weather.

[illegible] however [illegible] skaters [illegible] hockey [illegible] Stanley Cup battle [illegible] the ice, the bunched players of the New York Rangers and the Toronto Maple Leafs swinging from one end of the rink to the

Three views of the goalie in action are shown above and at right. In one he has fallen but is stopping the puck with his hand. Upper right, kneeling on the ice, he stops the puck with the back edge of his stick. Unable to prevent a goal any other way, the goalie is doing a split and stopping the puck with skate blade

Left, one of the frequent spills that make hockey exciting. Below, Americans' goalie, Roy Worters, exhibiting the protective armor he wears while engaged in guarding the goal

IT TOOK smart skating to [illegible] the same time keep an eye on the puck. But pro hockey stars are among the best skaters on earth. Most of them are Canadians. They have grown up on skates and have been chasing a puck since childhood. Last year 1,200 hockey players were registered with various clubs in Canada.

Playing in three twenty-minute periods, they seek to [illegible] into a net four by six feet in size a three-inch vulcanized rubber disk, using curved sticks a little more than four feet long. Each team has six players, Goal, Right Defence, Left Defence, Center, Right Wing, and Left Wing. The game is a high-speed version of "shinny on the ice," played with such reckless abandon by professionals that one sports writer describes it as "a combination of forked lightning, old-fashioned shinny and second-degree murder."

Rink hockey, such as is popular in the United States, is far harder on a player than the outdoor game of Canada. Playing at top speed in a damp, close atmosphere, the average star burns himself out in five years. His legs give out first. The average big-time hockey player weighs about 155 pounds. "Ching" Johnson, defence ace of the Rangers, is an exception, tipping the scales at 210. Training begins about three weeks before the season opens in mid-November.

The veteran of the game is Bul Cook, probably the greatest right wing of all time. He has been in professional hockey for twenty years. Last year, for the second season in succession he was high-point scorer in the National Hockey League. Twenty-eight times, the red light behind the opponent's net flashed on to indicate goals he made. After the four-months hockey season each year he retires to his wheat farm in Saskatchewan. His brother, Bun Cook, is also a star of the New York Rangers. Some years ago, a professional team in Canada was composed of nothing but Cooks, five brothers and a cousin making up the sextet.

One side light on how interest in hockey has climbed in recent years is the rise in value of a franchise in the National Hockey League. In 1924, when the league was just getting under way a franchise for one of the big cities cost about $3,000. By 1929, it had increased to $75,000. And, today, it stands at a hundred times its original figure, approximately $300,000.

In the league, last year, there were nine teams, the New York Rangers, the Boston Bruins, the Toronto Maple Leafs, the Montreal Maroons, the New York Americans, the St. Louis Eagles, the Detroit Red Wings, the Montreal Canadiens, and the Chicago Black Hawks. Five of the teams were American, four Canadian. The Boston Bruins, alone, grossed in gate receipts more than a quarter of a million dollars.

A chief drawing card of the Bruins is Eddie Shore, "the human gyroscope." Hard to upset, he moves over the ice like a whirlwind. In action, he has been described as "most resembling the rear end of a transcontinental bus out of control on a steep hill." The eleventh-hour trick of the Bruins is the "Shore charge." Taking the puck in his own territory, Shore launches full tilt down the ice followed by two of the fastest forwards. Nearing the enemy net he lifts the puck and crashes it not into the cage but against the backboard. His momentum carries him through the opposing defense. He retrieves the puck and shoots it back to one of the forwards who has just swooped into position for a shot that flashes on the goal light.

Off the ice, Shore is mild and soft-spoken. Careful about his physical condition, he neither drinks nor smokes and on trips always takes his own drinking water with him. Summers he raises pigs on an Alberta farm. But in the heat of a game he goes wild and his reckless playing has brought him a record number of injuries. He carries more than thirty scars and nearly 500 stitches have been taken in his anatomy during his playing career. Once, after he had defeated an opposing team almost single-handed at Montreal, he left the ice with a broken nose, a broken jaw, two black eyes and six teeth missing.

Another Spartan of the ice, Ching Johnson, defence man of the Rangers, played through a Stanley Cup match wearing an aluminum protector to hold a broken jaw in place. In the same game, red-headed Reginald Horner of the Leafs, shot the winning goal with a broken hand encased in a plaster cast.

Although hockey is a high-speed game played on a hard surface, the men never wear helmets. Last year, a step in this direction ended in a fiasco. Two Montreal Canadiens, Gagnon and Mondou, skated out on the ice wearing queer black headgear suggesting derby hats shoved down over their ears. When the band struck up the National Anthem, which is a preliminary to every game, Gagnon couldn't get his helmet off and, when the game started, Mondou couldn't keep his on. That ended the helmet idea for the time being.

Shin guards, shoulder pads and knee protectors form the meager armor of the players with the exception of the goalie, who is mattressed with extra padding to withstand the blows of the whizzing puck, and the roughing he gets in close play. Last year, a new ruling went into effect to aid the goal tender. It prevents players from crossing a line fifty-seven inches from the mouth of the goal unless they are carrying the puck.

Another curious rule was added to those already in force by officials of the National Hockey League. It specifies that all players must wear skates! It seems that some years ago, a

With this electric driven plow and the squeegee which is dragged behind it, ice is removed from indoor rinks and the concrete floor is thoroughly dried

goalie was injured in a game at Iroquois Falls, Ontario. Having no regular substitute, his team sent in a spectator who could play lacrosse but could not skate. He wore rubber overshoes. The opposing team set up an indignant shout. But when they consulted the rules they could find no specific provision that players had to wear skates. So, last year, N. H. L. officials decided to prevent future misunderstandings by adding the rule every one had taken for granted.

Showing how players get hurt. Note stick landing across man's face

A few years ago, when the rules were altered in connection with substitutions, the manager of the Chicago Black Hawks tried to apply a football idea to hockey. He developed two teams, one almost as good as the other and shifted them at eight or ten-minute intervals during the game. One squad was drilled at offense, the other at defense. When the tide was running against the Hawks, the defensive aces went in and blocked the slashing attack of the opposing squad, when the enemy was on the run the scoring crew took up the battle.

One of the longest professional hockey games on record took place two years ago between the Boston Bruins and the Toronto Maple Leafs. It lasted two hours and forty-four minutes and ended in a one to nothing score for the Leafs. In hockey high scores are rare. Goals are hard to make. Such defensive stars as Andy Aitkenhead, of the Rangers, and Lorne Chabot, the lean goalie of the Leafs who has worn the same lucky trousers in every game for five years, have run up phenomenal records in goal tending. They stop the puck with hands, feet, skates, stick and body. Out of 137 shots by opponents in five games, Aitkenhead stopped all but nine. And one of these was a freak drive that landed in the net by luck.

It occurred during a nip-and-tuck battle between the Rangers and the Leafs, leaders in the race for the Stanley Cup. Hec Kilrea, of the Toronto team, shot a high one down the scratched and powdered ice. The skimming puck bounced off the bald head of Ching Johnson and skidded into the net. Usually a sextet that can shoot the rubber disk past the goal tender into the net three times in an hour of fighting stands a good chance of winning the game. That is the average score of big-time contests.

Because the taut netting at the back of the goal cage sometimes caused the puck to rebound at high speed so the referee could not tell whether a goal had been made or not, the design of these wire enclosures was altered a few years ago. Now, most of the cages have at the back wire deflectors shaped like huge reversed shin guards. They keep the puck within the cage once it enters the mouth.

After every game, players have their skates sharpened. In a basement shop across from Madison Square Garden, one expert, Warren Roach, does all this work during the New York season. The runners are ground on a rubberized wheel stoned and then finished with a rubbing of oil. Sometimes as many as 150 skates pass through his hands in a single day.

The beginning of hockey dates back to 600 B.C. or before. In 1922, archaeologists unearthed an ancient sea wall near Athens, in Greece. On it they found carved in bas relief the figures of athletes striking at a ball with curved sticks. The carvings were twenty-five centuries old and dated to the time of Themistocles.

The Aztecs in Mexico played a similar game and a favorite pastime of the American Indians was chasing a ball of deerskin or a pine knot, with curved sticks. Sometimes, the dried leg of a deer was employed as the stick. When the earliest French settlers occupied the region of the St. Lawrence, they took up the sport and it has become the traditional game of Canada.

In the United States, outdoor hockey has remained a minor sport. The recently organized Intercollegiate Quadrangular Hockey League brings Yale, Harvard, Dartmouth, and Princeton together in an annual series for the Hobey Baker Trophy given in honor of the famous Princeton athlete of twenty years ago. But few, if any, collegiate hockey stars ever make the professional teams.

It is rink hockey, with its whirlwind skating and brilliantly reckless offensives, that is a modern American development. With gate receipts soaring to seven figures, with players drawing as much as $7,500 a season with *(Continued on page 109)*

Hockey skates must be sharp and securely fastened to shoes, a job that keeps this man busy

Simple Home Tests of Scientific Problems

CELLULOSE TISSUE STOPS ACTION OF BURNING GLASS

With a bright sun shining, a burning glass, as you know, can be used to set fire to lint or even to dry leaves. If a piece of cellulose tissue is held between the lens and the sun the inflammable materials, no matter how dry it may be, cannot be ignited. This is because the tissue screens out the infrared rays responsible for the action

GAS FORMS WATER

To show that water is formed when gas burns, hold a flat iron over a gas flame for a second or two. When it is removed you will find so much dew on its surface that you can write your name in it. Obviously the experiment also indicates the presence of hydrogen

WATER GOOD SOUND CONDUCTOR

To show that water is a better conductor of sound than air, float a piece of wood in a jar of water as above. Then strike the tines of a fork to make them vibrate and hold the end of the fork against the wood. The volume of sound is greatly increased as the sound waves are transmitted into the air by the water

HERE'S THE PRINCIPLE THAT WORKS ATOMIZER

To understand the working of an atomizer, arrange it with a medicine dropper as at right. The atomizer contains water. Blowing a stream of air from the horizontal dropper into the atomizer will force the water up the atomizer tube and then out of the dropper into the air as fine drops that form spray

DEMONSTRATING ACTION OF ELECTRICAL FUSE

NICE LITTLE EXPERIMENT IN HEAT CONDUCTIVITY

The question is, which is the better heat insulator, cork or paper? To find the answer, wrap a bit of tissue paper about the end of a cork tipped cigarette as above. Then hold a lighted match under it. The paper over the cork will be charred thus demonstrating that paper is a better heat conductor than cork around the cigarette

RAISING BIG WEIGHTS WITH A SIMPLE PULLEY

Rig a pulley as shown, with a plane and scales attached. Pulling down on the scales will raise the plane half as far as the scales descend. This accounts for the mechanical advantage. If the scales read one pound, it is obvious that the plane's weight must be exactly twice this, or two pounds

New Kind of Planet Finder

YOU CAN MAKE AT HOME

. . . Simple Device, Showing Position of Bodies in Our Solar System, is Fully Explained in this Article

By GAYLORD JOHNSON

WHEN you have found the stars which make up a given constellation—such as Taurus or Scorpio—you can always rely upon finding them in their places, year in and year out. But keeping track of the five naked-eye planets—Mercury, Venus, Mars, Jupiter and Saturn—is more difficult. They are constantly shifting their positions from constellation to constellation along the road of the ecliptic. This steady travel accounts, in fact, for the very word "planets," which means "wanderers."

The easiest of these planets to keep in sight are Jupiter and Saturn—for the former takes a whole year to travel through one of the twelve zodiacal signs of constellations, and the latter remains over two years within a single sign. So if Jupiter is in Libra (the Scales) this year, we can rely upon finding it in Scorpio next year. And since Saturn is now (January 1, 1935) on the boundary between Capricornus (the Goat) and Aquarius (the Water Bearer), we can locate the ringed planet next year in the latter constellation, and only a little advanced in the sign, at that.

To find these two planets after once seeing them, requires no apparatus, but for keeping track of the three much more rapidly shifting ones—Mercury, Venus and Mars—a "planet finder" is a convenience, as well as a simple bit of construction which is fun to carry out.

The necessary apparatus consists of a transparent drum of sheet celluloid (or several layers of transparent wrapping folded together) and a series of five identical cardboard rings to slide easily around it like five narrow band rings on a single finger. There must also be a fixed ring at the bottom to support the five movable ones, and another fixed ring at the top to keep them in sliding contact with each other. A tiny knob of wood, glued to the outside of each movable ring, aids in turning it.

In cutting the transparent strip for the drum, leave about an inch beyond the map for a cementing-lap. Then, on this transparent strip, you trace with a pen and white ink the diagram given across the bottom of these pages. If the celluloid surface will not take ink readily, wipe the surface with a cloth moistened in soapy water, and dry.

After the pattern is accurately drawn in white outline, cement the ends firmly together with clear cement. Then channel a circular groove (to fit the drum's lower edge) into a piece of heavy pulp board cut into a circle. Into this cement the transparent ring.

The transparent circular cup you have made now represents the zodiac throughout the year. When held with the current date on the far side opposite your eye, the constellations seen facing you are the zodiacal star-groups which are in view when you face the southern horizon at 9 P.M. on that date. But keep always in mind that this date-band *has nothing to do with locating the planets on the ecliptic.* It merely shows you when the zodiac constellations are visible.

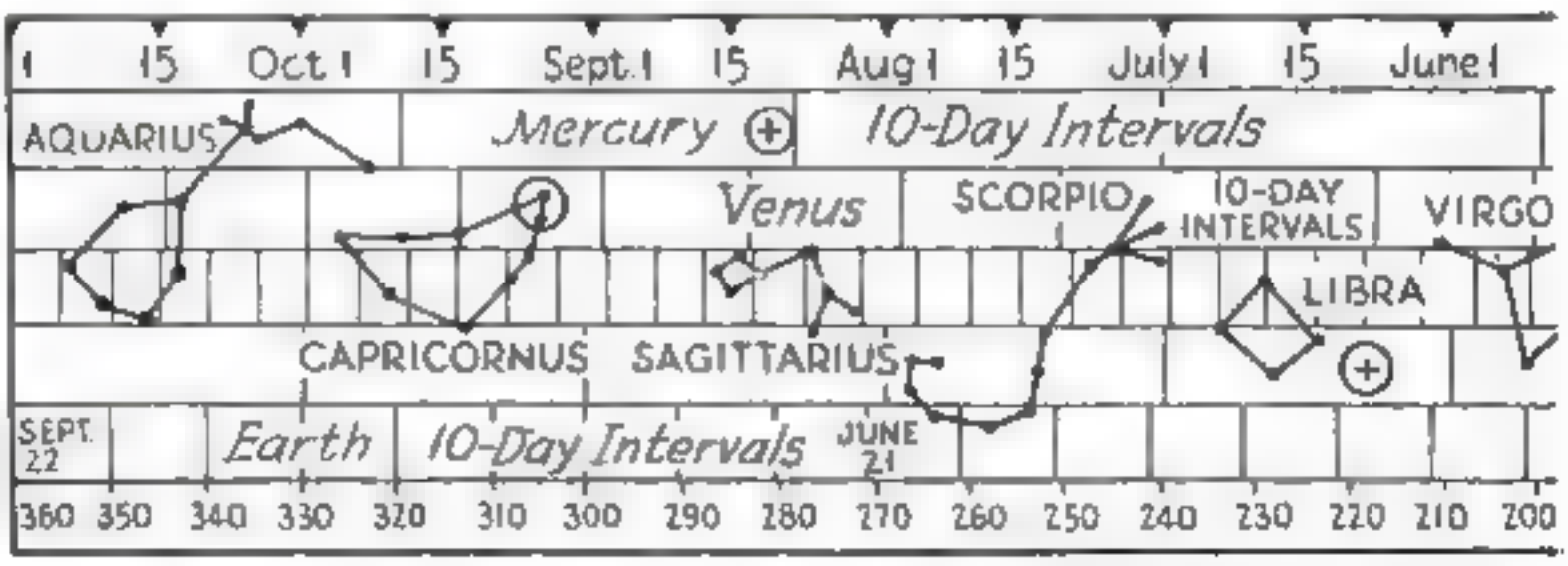
As you turn the drum from your left hand toward your right (clockwise) the twelve constellations pass along the strip of man-made sky just as they do throughout the year in the real sky.

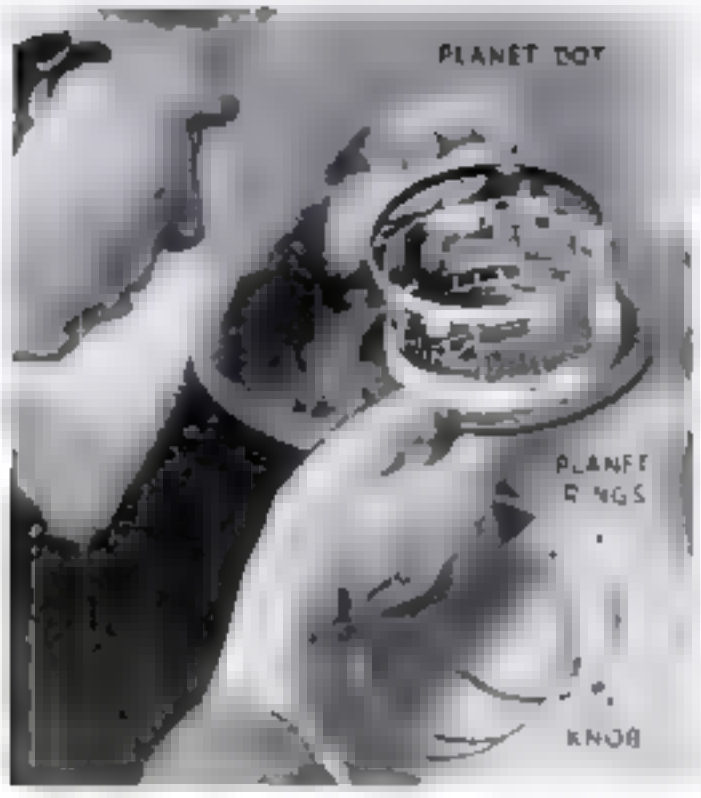
The small open circles marked at various points on the drum, along the five paths for the planets, represent the positions of Mercury, Venus, the earth, Mars, and Jupiter, *as they would be seen from*

USING THE PLANET FINDER. Each planet is represented by a white dot on the black inner surface of one of the movable cardboard rings. As the ring is moved the dot passes through a map of the constellations of the zodiac drawn in white ink on the transparent inner drum. The distance traveled by each planet in a fixed time interval is shown by vertical marks across its path. By counting forward from a mark showing its position on January 1, 1935, its position in its orbit at any future time can be easily determined.

MAP OF THE ZODIAC

To make the inner drum of the planet finder, trace the two diagrams at the right upon a strip of clear celluloid or a roll of transparent wrapping material. Cement the ends to form a ring and mount on the base. The circles show the positions of the various planets on January 1, 1935. They may be made more conspicuous by outlining with red water color. The planet rings are made of strips cut from Bristol board with blackened insides and a white dot to represent the planet each indicates.





ASSEMBLING THE RINGS. This photograph shows how the cardboard planet rings are slipped over the transparent drum. After all five are in place, the fixed upper "date ring" is cemented to the top of the drum. A small knob of wood, glued to the outside of each ring makes it easy to slide the ring around and follow the movements of the planet through the zodiac

the sun against the zodiac constellations on January 1, 1935.

Each of the large white dots on the inside of the black sliding cardboard rings which surround the transparent zodiac-drum represents a planet. When the five rings are all in position, the white planet-dots show clearly through the transparent drum and each moves as its ring moves.

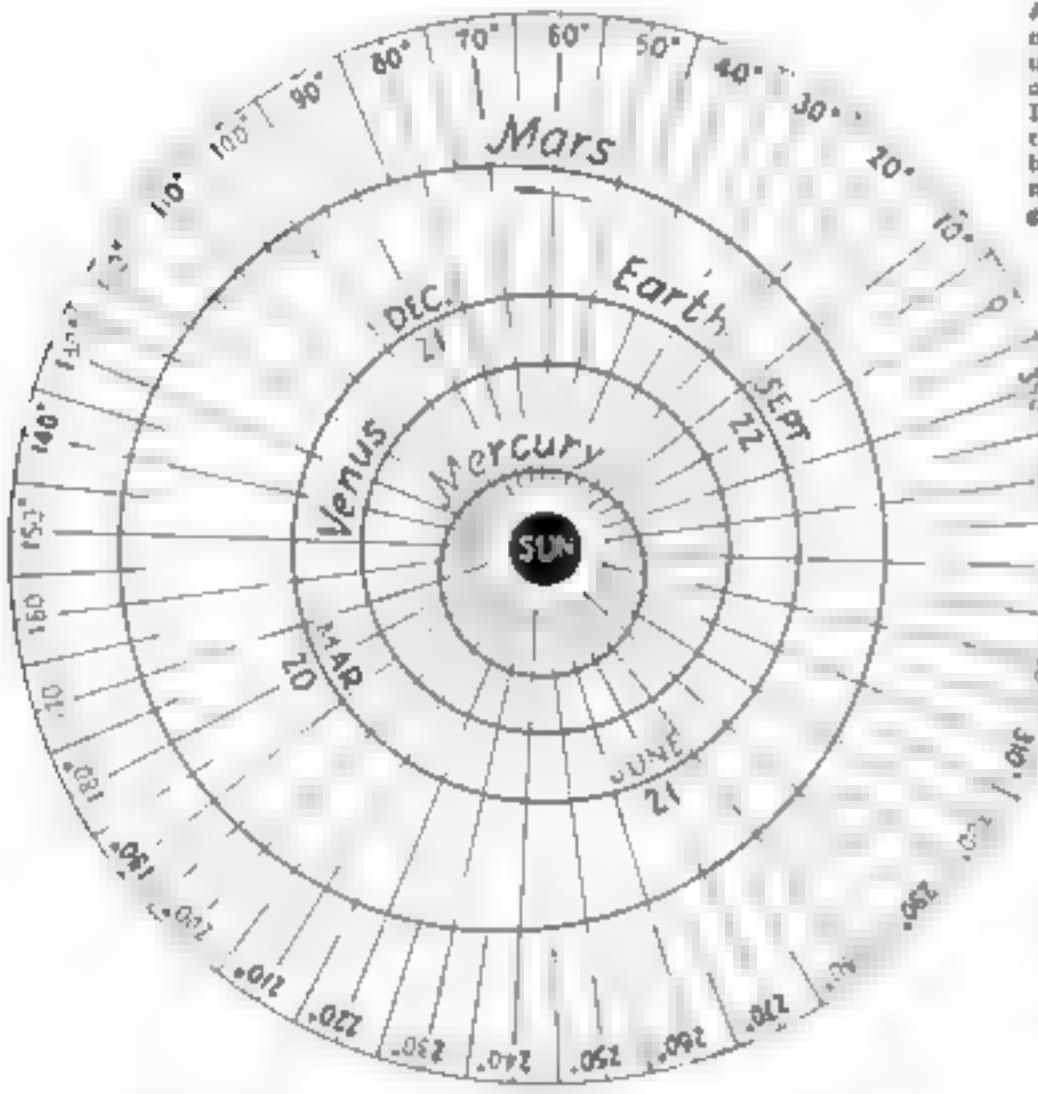
Accordingly, since each of the planet paths is marked off in regular time-travel intervals, it is easy to find the position of any planet, *as seen from the sun*, at any number of days, or even years, in the future—counting from the planet's position as marked for January 1, 1935

For instance, you wish to locate the position of Venus on May 1, 1935. From January 1 to May 1 is 120 days. This means that you must turn the white dot on the second movable ring through twelve of the ten-day intervals marked on the strip devoted to Venus. Begin at the planet's marked position for January 1 1935, and set the dot so that it coincides with the small circle indicating its position on that date. Then count off exactly twelve ten-day divisions along the path of Venus in a *counter*clockwise direction (from right to left along the visible half of the zodiac) and turn the Venus-ring until the dot shows through at the twelfth ten-day division. This dot then marks the position of Venus *as seen from the sun on the zodiac* at May 1, 1935. (Its "heliocentric" or "sun-centred" position)

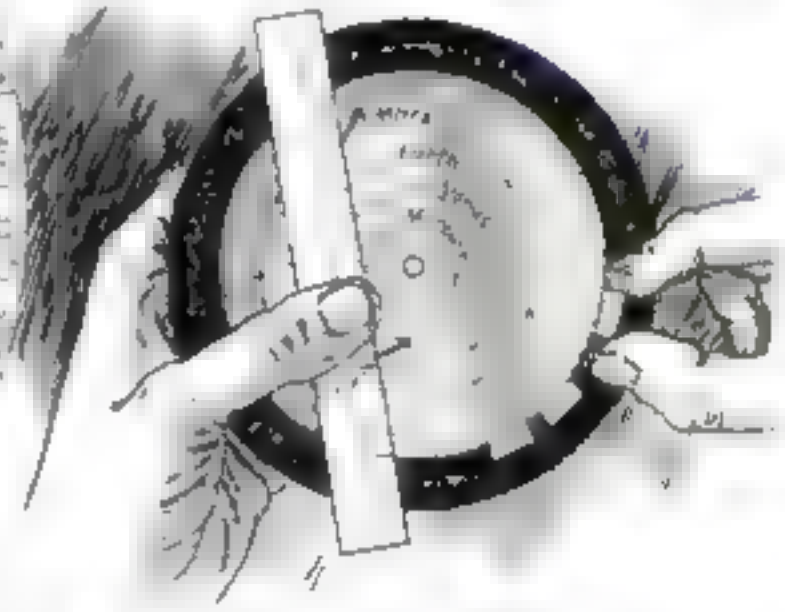
To find the position of the planet *as seen from the earth* at the same time (its "geocentric" or "earth-centered" position) we shall need to make use of the circular map of the planets' orbits, which must be traced off and pasted inside the bottom of the transparent drum. Note that this map is divided, from center to circumference, into degrees—from zero to 360. Paste in the map so that the degree numbers coincide all around on both map and drum.

In addition, we must make use of the movable ring which carries the dot representing the position of the earth *as seen from the sun*. (Its "heliocentric" position). This dot must first be put into its correct position against the zodiac.

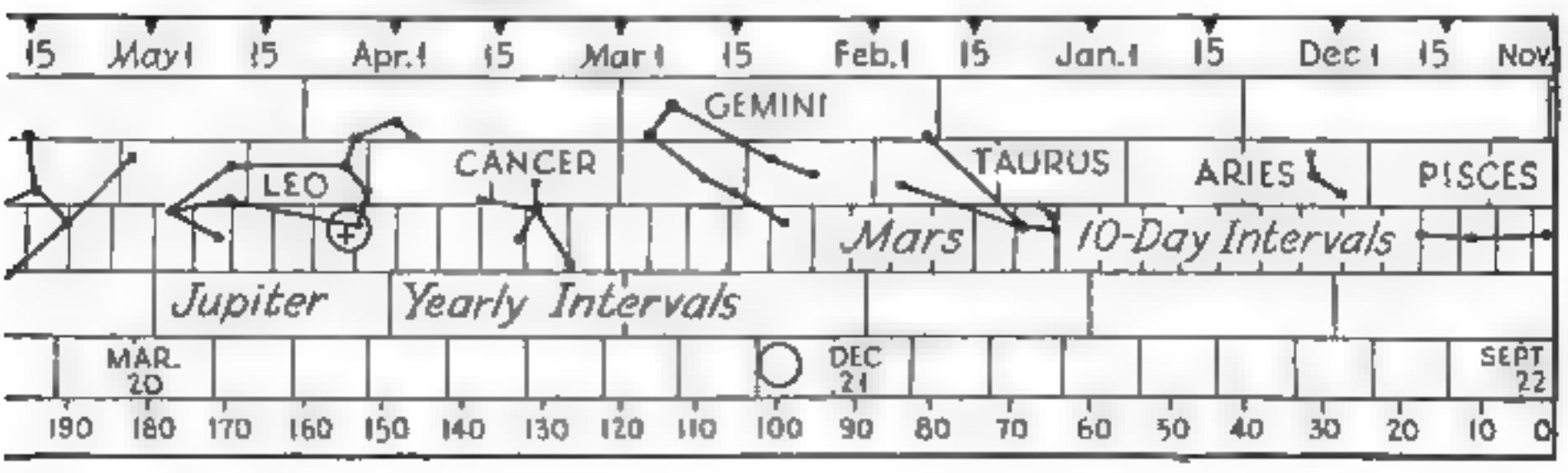
To do this, turn the ring until the earth-dot shows through the required date on its path (in this case May 1). This is also obtained by counting ten-day intervals from one of the four dates marked. Then note the degree-number on the scale immediately under it. Follow this same numbered degree-line toward the sun (on the bottom map) until it (Continued on page 110)



At left the degree map" which is pasted upon the inside floor of the planet finder. It must be placed so that the degree numbers coincide with the numbers on the degree ring" in the drum

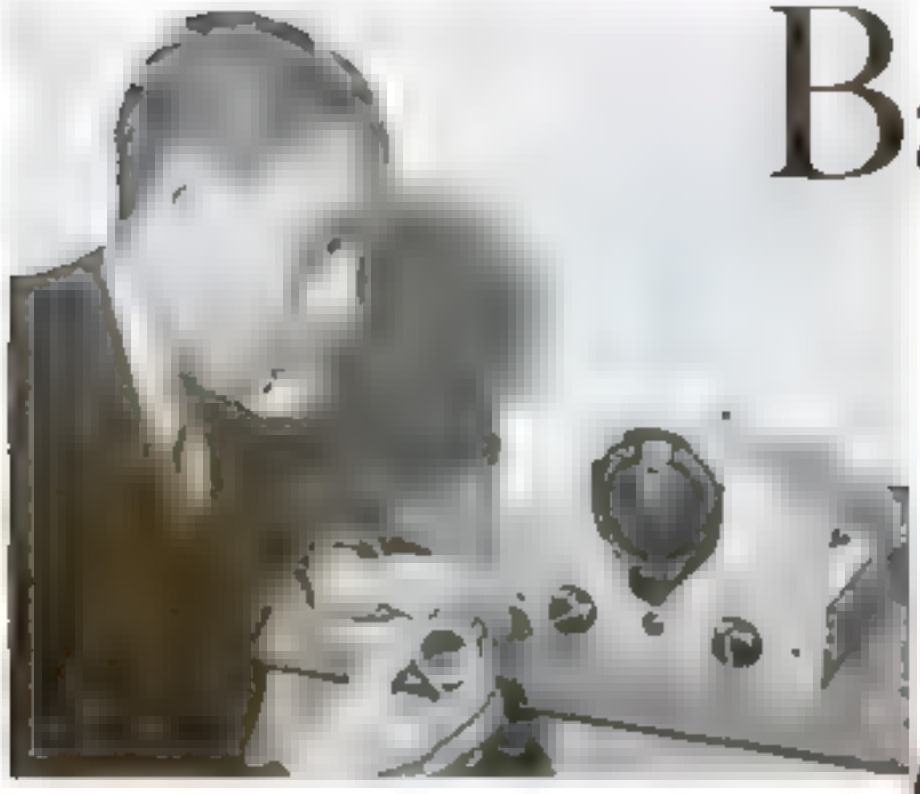


Above, drawing shows how apparent position of a planet, with reference to the zodiac, is found with a ruler



ANYONE CAN BUILD THIS

Band-Spread Receiver



Here is the author of this article winding one of the plug-in coils used with his improved two-tube receiver. Note the arrangement of the four controls as they appear when installed on the front panel

This rear view of the band-spread receiver shows location of the two tubes

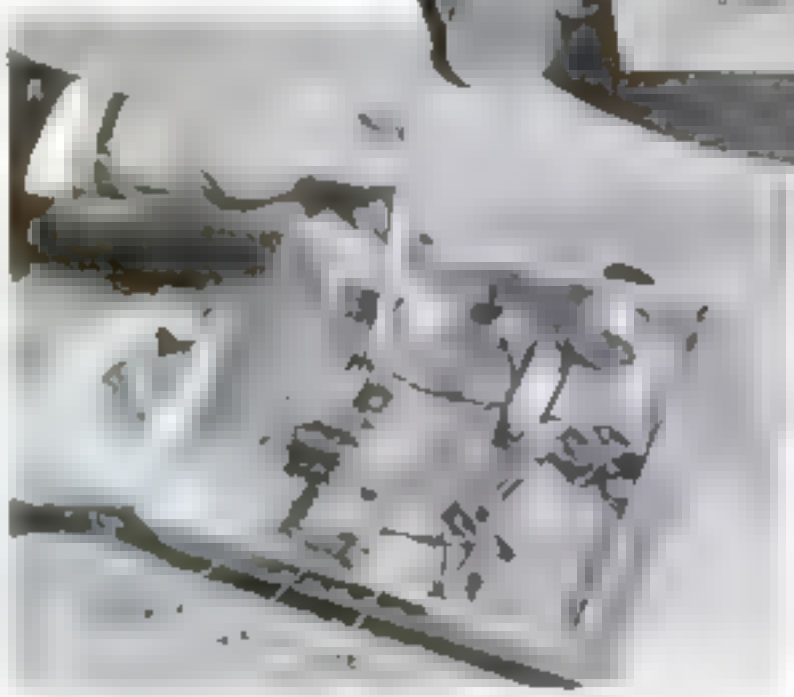
By LEWIS WINNER

BAND-SPREAD tuning plus up-to-the-minute parts make this receiver the last word in easily built short-wave circuits. It is the logical successor to the one-tube set that usually serves as the beginner's introduction to the higher frequencies.

Although diagrammatically the regenerative-detector resistance-coupled amplifier hook-up appears far from revolutionary, several changes and improvements make for better all-around operation. First of all, the circuit is built around two tubes of the latest vintage, a screen-grid 6D6 detector and a type '76 amplifier. For smoothness, regeneration control is dependent on the screen-grid voltage to the 6D6 varied by means of a 50,000-ohm carbon potentiometer (R^2).

A change for the better has also been made in the variable condenser arrangement included in the antenna circuit. A new type of air-padding condenser has been substituted for the inexpensive, but hard-to-control, equalizer or trimmer condenser (3 to 35 mmf.) generally used. Being in reality a sturdy miniature variable condenser whose tiny semi-circular plates measure less than seven sixteenths of an inch in radius, it overcomes all the difficulties associated with the two-plate mica type. It is easy to adjust and, because of its rigid multiple-plate construction, holds its setting regardless of vibration or temperature changes. As with any circuit of this type, this condenser is included to provide a means of balancing the receiver to make it oscillate over the full range or band for each of the four plug-in coils. In the completed receiver, it is mounted under the chassis with its adjusting slot projecting above the top face. It is regulated with a screw driver.

Since it eliminates troublesome crowding by spreading the stations over a greater portion of the tuning dial, the band-spread feature of this receiver is particularly valuable to the active amateur. It is obtained through the use of two condensers connected in parallel across the grid winding of the plug-in coil current. Condenser C^1, mounted under the chassis, is the course- or band-setting unit, while C^2, adjusted with the large central dial, is the final tuning condenser. In use, once C^1 has been set for a given frequency band, tuning within the band is accomplished entirely with C^2.



Underview of the set. Note the recently developed air padding condenser. It is the midget of all midget condensers

Aside from the 2-by-7-by-10-in. aluminum chassis and the 7-by-10-in. aluminum panel, the following easily obtained parts are used in the construction of the set.

C^2—Variable condenser, 140 mmf.

C^3—Variable condenser, 35 mmf.

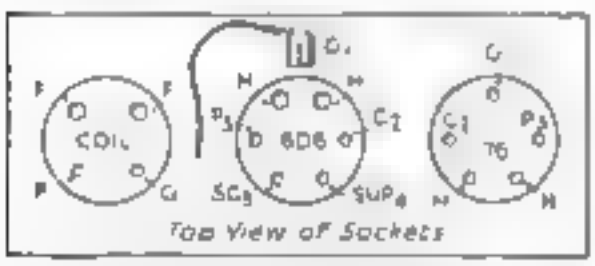
C^4—Variable air-padding con-

denser, new utra-midget type, 50 mmf.
C⁴.—Fixed condenser, .00025 mfd.
C⁵.—Fixed condenser, .01 mfd.
C⁶.—Fixed condenser, .1 mfd., 200 volts.
C⁷.—Fixed condenser, .25 mfd., 200 volts.
C⁸.—Fixed condenser, .00015 mfd.
R¹.—Grid leak resistance, 1 to 5 megs.
R².—Potentiometer, 50,000 ohms.
R³.—Fixed resistance, 500,000 ohms.
R⁴.—Fixed resistance, 10,000 ohms, 2 watts.
R⁵.—Fixed resistance, 100,000 ohms.
RFC.—Radio frequency choke, 2 mh.
Miscellaneous. Four four-prong coil forms, wire for coils, one four-prong isolantite socket, one six-prong isolantite socket, one five-prong wafer socket, one type 6D6 tube, one type '76 tube, one power terminal strip, one phone terminal strip, one antenna-ground terminal strip, one single-pole, single-throw toggle switch, dial, knobs, screws, solder, etc.

If you have constructed any of the other simplified short-wave circuits that have appeared recently (P. S. M., June '34, p. 64; July '34, p. 64; Aug. '34, p. 66, Oct. '34, p. 63), you undoubtedly will have some of these parts on hand. However, before using them make sure that they are in working order and match the specifications to the letter.

The set of four plug-in coils used can be home-wound or of commercial manufacture. Complete winding specifications are given in a convenient tabulation elsewhere in the article. For coil forms, the author used a relatively new type known as the "rib-grooved" form, having an effective diameter of one and one half inches. To simplify matters, enameled wire is specified for the grid windings of each of the four coils. An improvement incorporated in the originals shown, however, consists of using silver-plated wire for the grid windings of coils A and B.

Although in the circuit diagram no common chassis connection is shown, the wiring can be simplified by those who desire. If the metal of the chassis and panel is made to serve as the common cathode and negative A-battery lead. In this case, of course, the ground terminal will be grounded directly to the chassis. If the socket drawings are followed in making



the connection, no wiring difficulties should be encountered. The numbers on the socket terminals shown directly above agree with those on the tube diagrams on the opposite page.

A little practice may be required before you learn how to use the band-spread condenser arrangement to best advantage, but once mastered, it will enable you to sift through the jumble of stations on each of the amateur bands. For your first try, simply set the main condenser C² to approximately twenty on the dial and then turn condenser C¹ until you hear the "chirps" that indicate stations. The final adjustment of C¹ should be approximately in the center of the busiest area on the dial. Condenser C² then can be adjusted to spread the stations in that band. By repeating this process with each of the four plug-in coils, settings for C¹ will be obtained for the center portion of each band. By indicating these points, condenser C¹ can be adjusted quickly to correspond with the particular coil being used.

Hides AUTO RADIO under Floor Boards

In this photo is shown the new method of installing an auto radio beneath car's floor boards

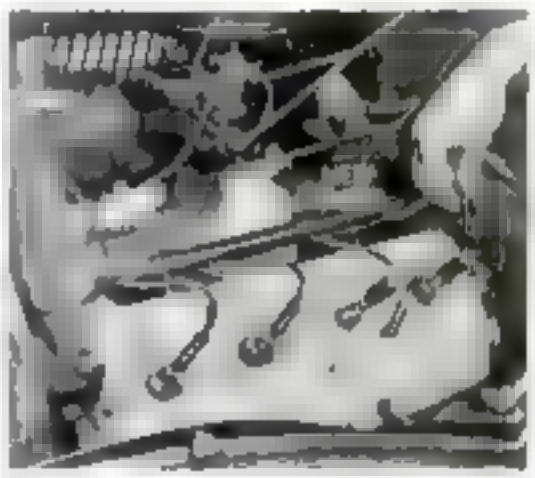
ALTHOUGH most radios in automobiles are mounted under the instrument panel, they can be installed almost anywhere in the car. How one ingenious fan made the most of remote control to hide his receiver under the rear floor boards is shown in the photograph above.

No special equipment was needed for this installation, a standard commercial receiver of the unit type having a flexible tuning shaft being used. The receiver box was mounted under the rear floor boards in a water-tight metal compartment, a hole being cut and protected with a grille to expose the speaker, while the remote control was fitted into the upholstered arm at the right of the rear seat. It was a simple matter to thread the flexible tuning cable through the side upholstery to the receiver, while the necessary battery connections were shorter than those usually required.

Aside from the convenience of having the receiver controls handy to those in the rear seat, the owner also finds that the new position of the receiver and speaker improves the tone and sound distribution. Other variations of the same idea would be to mount the receiver under the rear floor boards and the tuning control on the steering wheel post or to install the receiver and control in the usual way and merely hide the speaker under the rear floor boards.

With auto radio entering its third year of popularity, many new accessories are on the market. Newest of these is an ignition noise eliminator. Differing from the usual suppressor, which in reality is simply a resistance, this new unit is a carefully designed radio-frequency choke. According to its manufacturers, these noise filters have high impedance to radio-frequency oscillations and exceptionally low resistance to the low-frequency components of the ignition sparks.

Along the same lines, the perfect shielding of the newer cars being designed for radio makes it possible, in most cases, to eliminate all but one of the suppressors used heretofore. Instead of the usual units connected to the spark plugs and distributor, a single unit of a slightly modified construction, inserted into the center high-tension lead to the distributor head, may be used with good results.



The manner of replacing the suppressors, left, with the new filters, right, is shown above

COIL SPECIFICATIONS

Coil		Tickler (L_2) Turns	Grid (L_1) Turns
A	17-41 M.	3.8-No. 32 DSC.	8.3 No. 16 Enam.- 7 per inch.
B	35-75 M.	5.8-No. 32 DSC.	17.7-No. 20 Enam.-32 per inch.
C	66-150 M.	10.8-No. 32 DSC.	37.7-No. 24 Enam.-24 per inch.
D	135-270 M.	14.8-No. 32 DSC.	81.7-No. 28 Enam.-44 per inch.

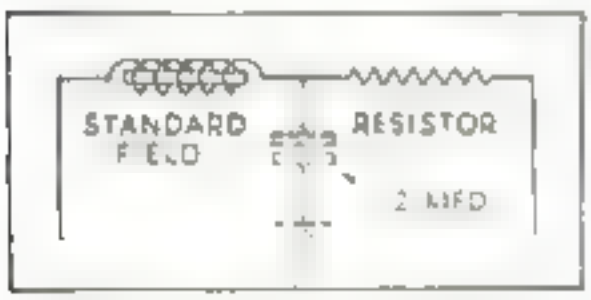
Tickler spaced 3/8 in. from grid coil, both wound clockwise on forms of 1½ in. effective diameter

New Kinks for Radio Fans

Cutting Out the Hum on Home-Built Receiver

EXCESSIVE hum undoubtedly is the most common source of trouble in the home-built regenerative receiver. If the set is of the alternating current type, the logical conclusion is that the power supply is at fault. An unshielded grid condenser and grid leak, however, can be an equally prolific source of hum. To remedy this on screen-grid detector receivers, use a postage-stamp size condenser in conjunction with a small half-watt grid leak and mount them directly on top of the detector tube grid clip as shown. The shield for the tube then will cover the condenser-grid-leak combination as well. To eliminate possible grounds, the metal shield cap should be lined with cardboard. If this fails to remove the hum, try grounding one heater line at the detector tube socket before laying full blame on the power supply.—J. A. Worcester, Jr

Simple Way to Match Your Dynamic Speaker

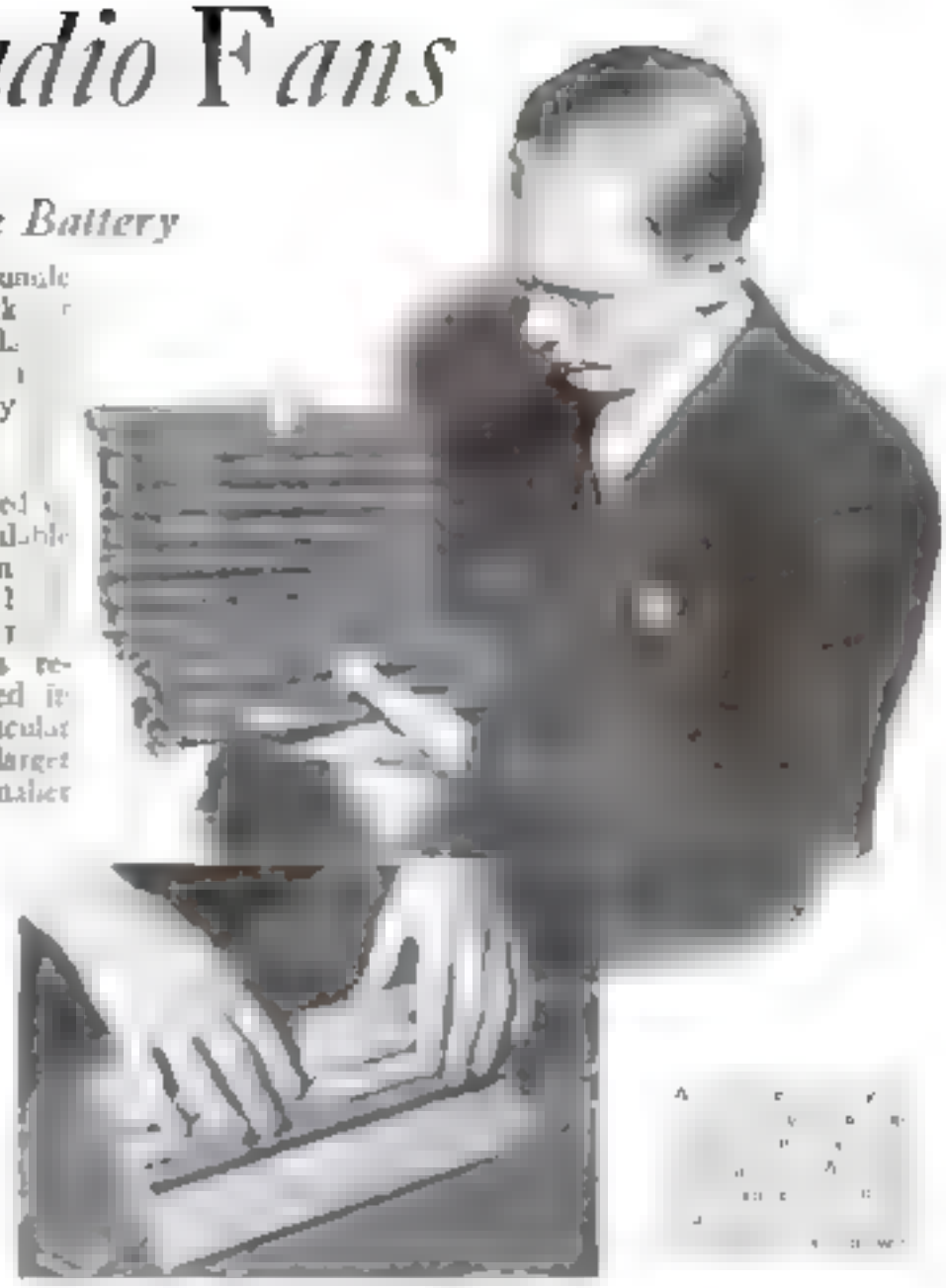


In this diagram a simple way of making any speaker whose field resistance is less than the original, serve with your set is clearly indicated

WHEN a loudspeaker in a commercial broadcast receiver fails, the owner often is unable to find a replacement whose field resistance exactly matches that of the original. However by following the simple procedure outlined in the diagram, above, any speaker whose field resistance is less than the original can be made to serve. Simply connect a ten-watt, wire-wound resistance of just the right value to bring the total resistance up to that of the original in series with the new field. If a slight hum results when the substitution is made, connect a two-microfarad, 300-volt condenser between the circuit and ground as shown by the dotted lines in the drawing.—J. P Kennedy

New Flexible Battery

RESEMBLING a bundle of dynamite sticks or Roman candles, the L... in radio B batteries ... flexible unit especially signed for portable ... Called the "ribbon ... tery," it can be folded ... rolled to fit the available space. In fact it even ... be worn around the ... under the coat where ... mum portability is required. Manufactured ... two sizes, the particular battery shown is the larger 114-volt type. The smaller unit, resembling a cartridge belt because of its two- and three-quarter-inch width, provides a twenty-eight and one-half-volt B supply. Since boxes and heavy wax are eliminated entirely, these flexible batteries are fully twenty-five percent lighter than rigid batteries.



Pocket Mirror Proves Handy Radio Tool

STRANGE as it may seem, a small pocket vanity mirror can be put to good use in the radio experimenter's tool kit. Held under various parts inside the chassis of a receiver, it can be used to read hidden specification labels when selecting replacements for faulty units. Invariably, the part in question is soldered in so that its label is on the underside, but the mirror trick solves the problem. Incidentally, the mirror also comes in handy to reflect light into the dark recesses of a cabinet and thus make it an easy matter to see and study the various parts that are otherwise invisible. A small dental mirror also is handy when inspecting soldered joints.

Cheap Tube Tester for Amateur Experimenter

WITH the inexpensive tube tester illustrated any radio set builder can afford to check his supply of tubes for leaks and shorts. Arranged to accommodate both large and small four-, five-, six-, and seven-prong tubes, it indicates leakages up to a million ohms as well as direct short circuits. All that is necessary is to plug the tester into any 110-volt line, insert the tube to be tested, and watch the small neon lamp at the rear of the panel. If it glows, a defective tube is indicated. A pair of jacks and test leads also are included.

An inexpensive tester to check tubes for shorts and leaks

Question: Define a strong wind, a gale, and a hurricane.—E. H., Richmond, Va.

Here's *the* Answer

A.—TECHNICALLY, the difference lies in their speed. According to the United States Weather Bureau, a strong wind is one ranging from twenty-five to thirty-eight miles an hour, a gale is a wind blowing from thirty-nine to fifty-four miles an hour, while a hurricane is one blowing faster than seventy-five miles an hour. When a wind blows between fifty-five and seventy-five miles an hour it is called a "whole gale."

The Whistling Buoy

G. E. V., ATLANTA, GA. A long tube filling with water as the buoy tosses in the sea is responsible for its whistle. Air trapped in the tube as the buoy rises is forced out through a whistling pipe when the buoy falls. The water, rising and falling, acts as a piston to alternately suck the air in through a check valve and force it out through the whistle.

We've Heard of Snake's Hips

Q.—IS IT true that snakes having legs sometimes are found?—T. T., Watertown, N. Y.

A.—ALTHOUGH the story often is told of snakes sprouting legs when thrown into a fire, there is little fact to back it up. Prehistoric snakes undoubtedly boasted legs, but the chances of finding a legged snake today, especially among the common North American varieties, is extremely slim.

Mississippi Mud

C. L., MEMPHIS, TENN. It is estimated that the Mississippi River dumps more than 400,000,000 tons of dirt into the Gulf of Mexico every year.

Airplane Speed Limited

F. T. V., PITTSBURGH, PA. Besides the human factor, the speed of the modern airplane is limited by the maximum possible speed of the internal combustion engine used to drive it. At present, this is placed at about 600 miles an hour, but, of course, this factor varies as new developments are made.

How High Are the Tides?

D. F. G., BUFFALO, N. Y. Few sections of the world's coastlines experience the same rise and fall of tides. Much depends on location. Tides vary from less than a foot along the coast of Panama to more than sixty feet at the Bay of Fundy, N. B.

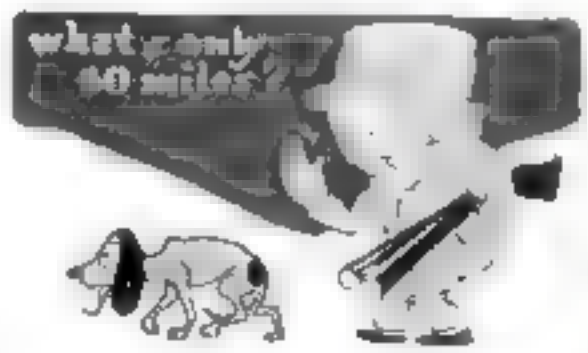
Drops Claw, Flees Trap

H. B., CLEVELAND, O. When a crab or a lobster finds his leg or a claw caught in a trap he simply discards that particular member and escapes. This leg-discarding action is entirely automatic, the injury causing muscles to contract which pull the leg up and literally pry it off by pushing it against the body-shell. In a short time, a new leg or claw grows out of the old stump.

When the Parachute Fails

Q.—WHEN a pilot jumps from his plane at 4,000 feet and does not open his parachute until he has almost reached the ground, how fast is he traveling at the moment the 'chute opens?—V. B. S., New York, N. Y.

A.—IT IS thought that a falling body reaches a maximum speed of about 200 miles an hour after falling 2,000 feet. From that point on, because of air resistance, it continues to fall at the same speed.



Wanna Race a Duck?

H. D. V., NEW HAVEN, CONN. Speeds of forty and fifty miles an hour often are attained by the eider duck, according to the American Museum of Natural History.

Just Sales Talk

Q.—IS ONE horse power equivalent to the strength of one horse?—O. P., Seattle, Wash.

A.—NOT exactly. When James Watt tried to sell his steam engine as a substitute for horses, he sought to compare its power with that of the average horse. Borrowing a brewery horse, he found the animal could do 22,000 foot pounds of work a minute. Then, allowing for generous losses of fifty percent, he decided that 33,000 foot pounds a minute was the average horse's power. It is whispered that Watt, mixing business with science, placed the figure ridiculously high for fear of some day meeting a super-horse that would outwork his engine.

Porcupine No Marksman

Q.—IS IT true that the porcupine can shoot his quills by swishing his tail?—V. G., Jr., St. Louis, Mo.

A.—ALTHOUGH in thrashing his tail, the porcupine may loosen some of his 30,000 odd quills, he cannot shoot them at will nor aim them. His main method of defense is to protect his head and bristle his quills.

Sun Bends Buildings

Q.—DOES the heat of the sun have any effect on tall buildings?—F. H., Milwaukee, Wis.

A.—THE sun's effect on tall buildings is graphically shown in the case of the Washington Monument in Washington, D. C. The expansion of the shaft caused by the continual heat of the sun on the south side has made it shift as much as two and five eighths inches to the north.

Men's Memories Vs. Women's

E. R. T., DENVER, COLO. According to a recent test, a woman tends to remember the pleasant experiences in her life and forget the unpleasant ones, while a man generally remembers the unpleasant moments, forgetting the pleasant ones.

Fastest-Growing Tree

Q.—WHAT species of tree holds the record for growing speed?—P. A., York, Pa.

A.—THE balsa tree is the fastest-growing tree known. Although its seed is little larger than a pinhead, the tree often sprouts to a height of seventy-five feet and diameter of twenty-five inches in five years.

Stratosphere Hot

Q.—WHAT is the temperature of the stratosphere one hundred miles above the earth?—J. C. K., Boston, Mass.

A.—CONTRARY to popular belief, a Naval Research Laboratory report states that the band of stratosphere between sixty-two and 124 miles above sea level is at a constant summer temperature of about eighty-six degrees Fahrenheit regardless of day, night, or season.

Tornado's Measurements

D. F. G., ST. LOUIS, MO. On the average, a tornado's path is thirty miles long and 1,000 feet wide. In most cases, it travels forward at a speed of from *(Continued on page 110)*

By MARTIN BUNN

Landon put his ear to the opening of the oil filler pipe and listened while Gus turned the crank. "It's a regular hiss," he said

DOES YOUR CAR NEED

New Piston Rings?

"IF THERE'S anything that gets my goat," grumbled Gus Wilson, "it's the fellow who's always thinking there's something wrong with his car."

"Well, then, you'd better hide your goat," grinned Joe Clark. "Here comes the world's worst." Gus looked up just in time to see Ted Landon's car roll into the Model Garage driveway.

"Got time to check my anti-freeze, Gus?" the driver called.

"Sure thing," replied Gus. "Run her inside."

"And while you're at it," suggested Landon, "you might check the battery and kind of look things over. Seems to me she starts a little hard these cold mornings."

As Gus worked, Landon wandered around the shop inspecting the assortment of tools and parts. "Do all cars have cast iron pistons?" he asked, fingering one of the pistons on Gus's bench.

"Not by a long shot," replied the mechanic. "Aluminum-alloy pistons are just as popular. Then there are nickel-iron, cast-iron, and semi-steel pistons."

"Why so many different kinds? One type must be best."

"It's differences of opinion that make the world go 'round," replied Gus with a grin. "Each type has its good points and to argue their pros and cons is worse than a row over religion. Why the sudden interest in pistons?"

"Oh, nothing," the customer replied. "Only I've been thinking maybe I ought to treat this bus of mine to a new set of pistons and rings."

"What gave you that happy thought?" asked Gus, looking up from his work with surprise.

"The car's ready for them," Landon replied. "She's gone over fifteen thousand miles and seems to smoke more this winter than she used to."

"Smoke," repeated Gus.

"Yeah, especially when I first start her up. Sort of whitish and it puffs out of the exhaust in regular clouds."

"Plenty of brand new cars do that in cold weather," replied Gus with a chuckle. "That's just the cold air condensing the moisture and unburned gasoline. If that's all you've got on your mind, you can stop worrying."

"But that isn't all," Landon insisted. "She smokes sometimes going down hills."

"Some cars do that too. When the wheels work against the engine, the pumping of the pistons tends to push oil up into the cylinders. Naturally, as soon as you speed her up again, the oil is burned. You don't use much oil, do you?"

"About a quart in seven hundred miles," said Landon.

"Nothing so startling about that," Gus assured him. "Your car's a little older than it used to be. The bearings aren't so tight, and the moving parts are a little worn. Naturally, you're going to use more oil. You don't know what it is to feed an honest-to-goodness oil-pumper."

"Well, just what are the symptoms of worn piston rings?"

Without answering, Gus put down his tools and walked over to a group of cars parked at the rear of his shop. "Here's a first-class example," he said, pausing in front of a three-year-old sedan. "First of all, she eats a quart of oil every hundred miles and to trail her is like following a freight train through a tunnel.

"On top of that," Gus continued as he fished a crank out of the tool compartment and pushed it into the hole under the radiator, "she hasn't any compression. Here, turn this crank and you'll see what I mean."

"Does turn sort of easy," Landon agreed, as he wound the crank.

"Right. Now try cranking your own car."

This time Landon found the job a little more difficult. The crank seemed to resist him at regular intervals. "Got more spring to it," he reported.

"That's it. The rings are tight enough to hold compression," explained Gus. "Why, the rings on this other crate are so loose you can hear the pressure leak by."

Landon looked at him blankly. "You can *hear* it?" he said doubtfully.

"Sure. Pull the cap off that oil filler pipe and park your ear close to the opening while I turn the crank."

As Gus cranked Landon listened. A pleased grin spread over his face. "Well, I'll be darned," he exclaimed. "It's a regular hiss like gas coming out."

Gus nodded. "On some cars it's so bad you can hear it even when the motor's running. In any case, that's a blamed good sign of blow-by caused by leaky piston rings."

"How about the spark plugs?" inquired Landon, as he slipped the oil filler cap back into place. "Don't burn rings foul the points with oil?"

"Maybe yes and maybe no. It's a funny thing about all these signs of leaky piston rings—they don't always follow the rules. Had a car in here just the other day that had all the symptoms except one—high oil con- *(Continued on page 111)*

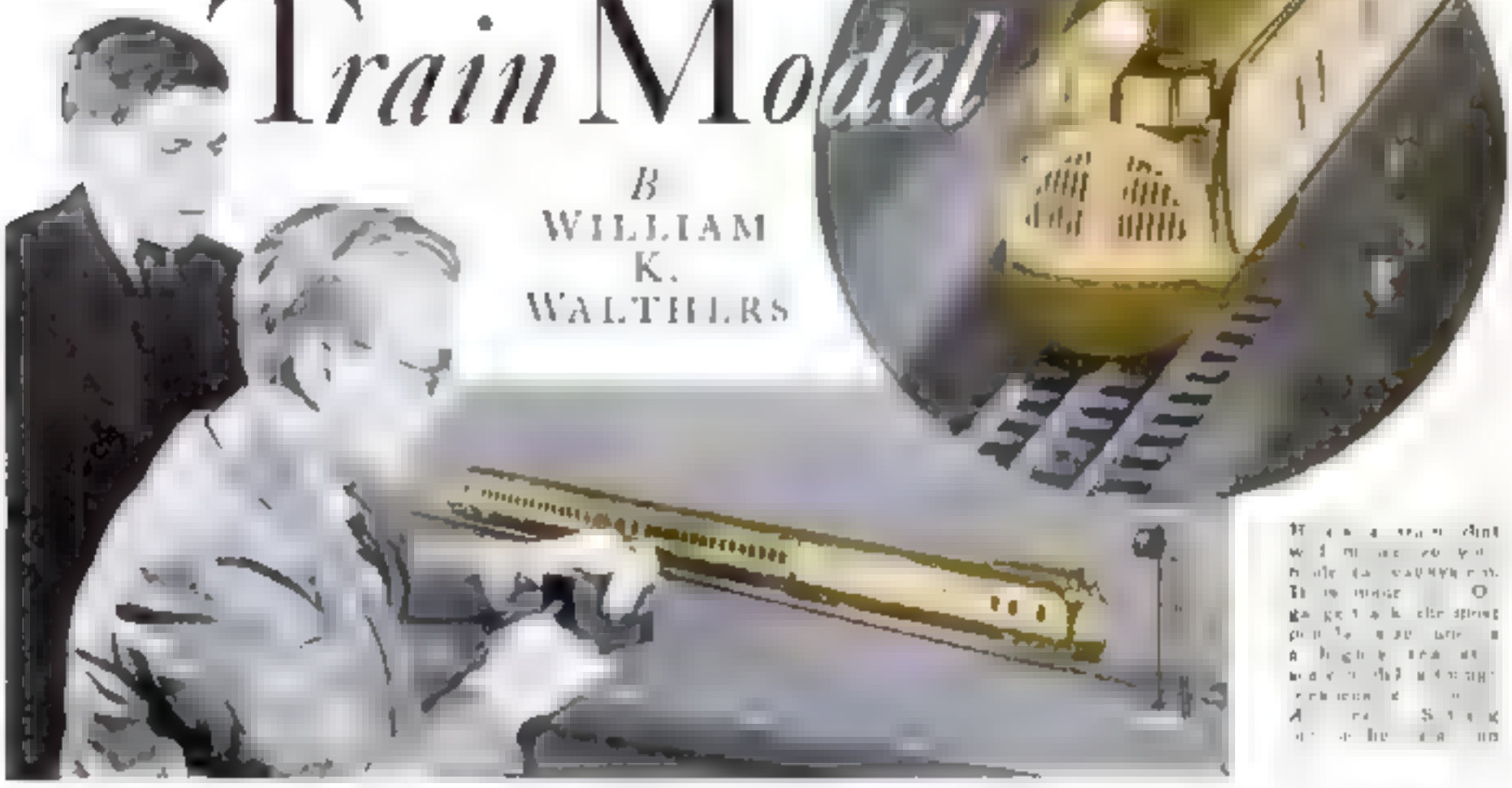
GUS says:

If your car isn't fitted with a cooling system thermostat you can eliminate a lot of the cold weather wear and tear on your motor by installing one. By stopping the water circulation until the motor warms up, it cuts down bearing wear, crankcase dilution, and gasoline bills by keeping your motor at summer temperature for most of your winter driving.

OLD TOY REBUILT INTO NEW

Streamlined Train Model

By WILLIAM K. WALTHERS



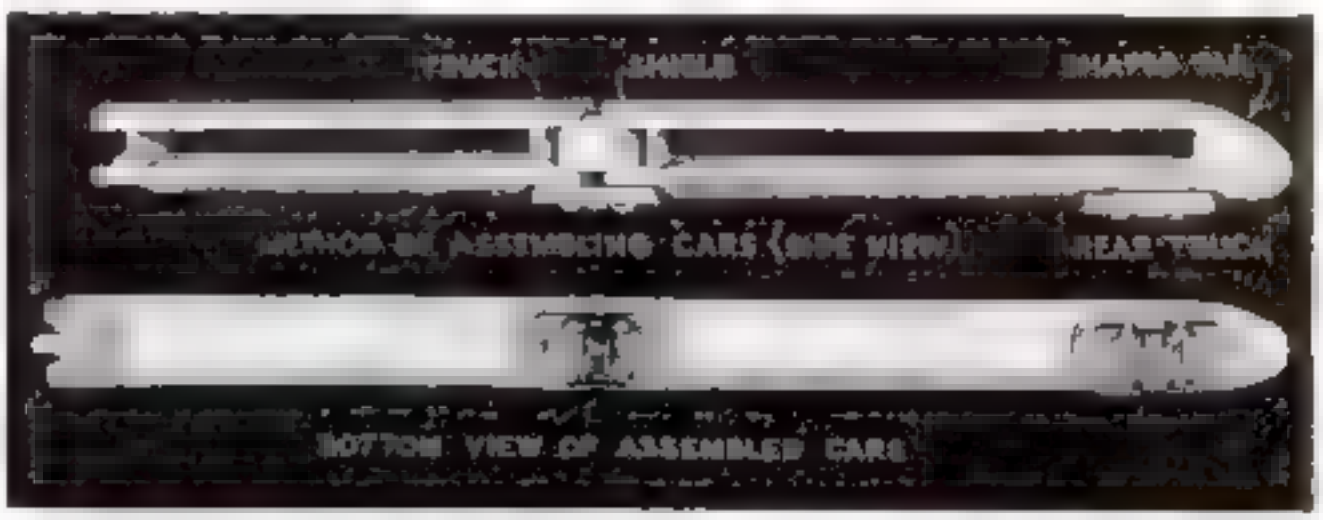
The cars are of pine and pressboard with made-over trucks—Discarded locomotive motor provides power

STREAMLINED trains are making history so why not add one to your model railway system? The model illustrated was built to the scale of ¼ in. equals 1 ft. from drawings of the famous three-car Union Pacific train *M-10,000* (see P. S. M. Jan. '35, p. 11).

No expensive materials are needed, and anyone, with time and a little patience can construct a train of this type. As far as size and detail are concerned, it is a miniature edition of the real thing. The total length of the model is 51 in. The long cars require a minimum radius of 48 in. for the curved track. This means that your toy track will have to be re-laid, or else the cars made shorter so they will take the usual toy curves. Shortening the cars will spoil the scale effect, but will not detract from the fun of building and operating the train.

The first thing to do is to obtain a suitable motor and the trucks because the rest of the train must be built around these. A regular "0" gauge toy locomotive motor will do. While the driving wheels are larger than they should be (1½ instead of ¾ in.), there is no harm in this as the wheels are concealed behind "skirts" and there is ample room in the locomotive car to swing the wheels when taking a curve. It is possible however to substitute wheels of the correct scale size by changing the wheel gears and adding two idler gears between the wheel gears and the intermediate gear, which is not disturbed.

In the author's model trucks such as are used on scale model freight cars were taken for the trainers. The wheels of these are just the right size, 11/16 in. in diameter. The journal box and spring projections were ground off the side frames to



Side view of the second and third cars before the pressboard sidepieces are added, and a bottom view of the same cars. A ⅜-in. brass pivot rod passes through the wooden shield, hinge bars, and truck frame

The right-hand [illegible] of the [illegible]. The left-hand view can be [illegible]

The [illegible] how the [illegible]

[illegible]

make room for the skirts used in streamlining. These skirts are made of brass strip 1/16 by ⅜ by 4 in. They are held in place by 2-56 flathead machine screws, which are tapped into the frame castings.

If trucks of this type are not available, others can be built up by using the wheels and axles from some old cars. How to do this is shown in drawings at right above.

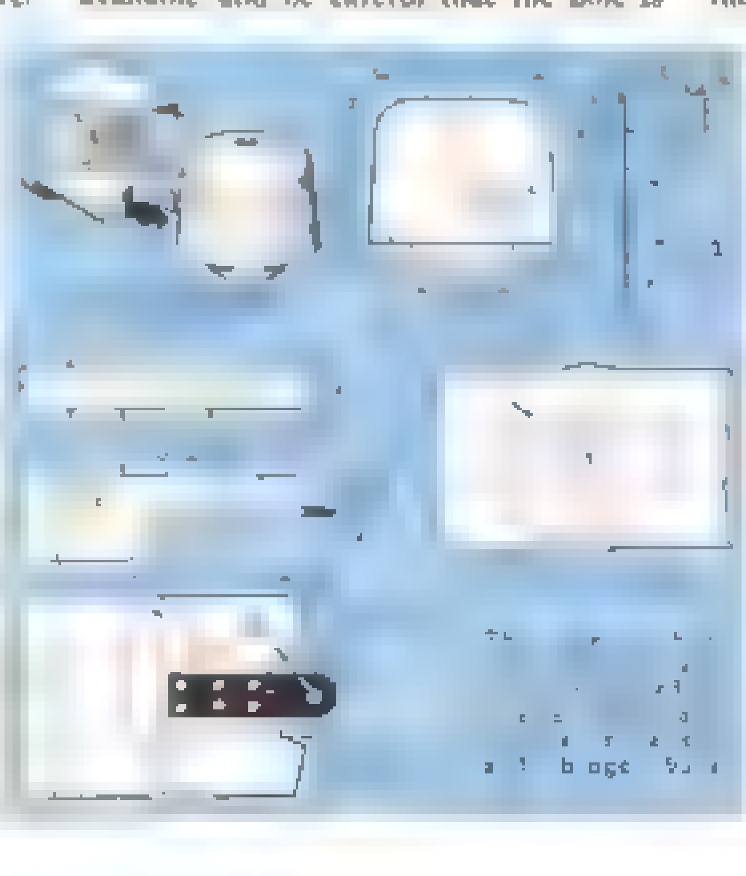
Each of the three rear trucks carries a center third-rail contact shoe, primarily for the car lights. This is made from phosphor bronze strip and is attached by means of a piece of bakelite so it is insulated from the rest of the truck.

The method of equipping the motor with skirts is shown in one of the photographs. A small bracket and a screw are added at the top of the motor so it can be suspended and pivoted from the top of the locomotive car. In placing this bracket (and the strap from which it pivots), take care to see that it is at the right height so the locomotive roof will be at the correct distance above the rails.

Use only clear white pine for the body framework. The dimensions for building the cars can be found with the aid of the ½-in. squares on the assembly drawings. The roof and floor are circular sections, the dimensions of which are given in a separate detail drawing. These can be planed at home, or some woodworking plant will make them for you. Five feet of each section will be ample.

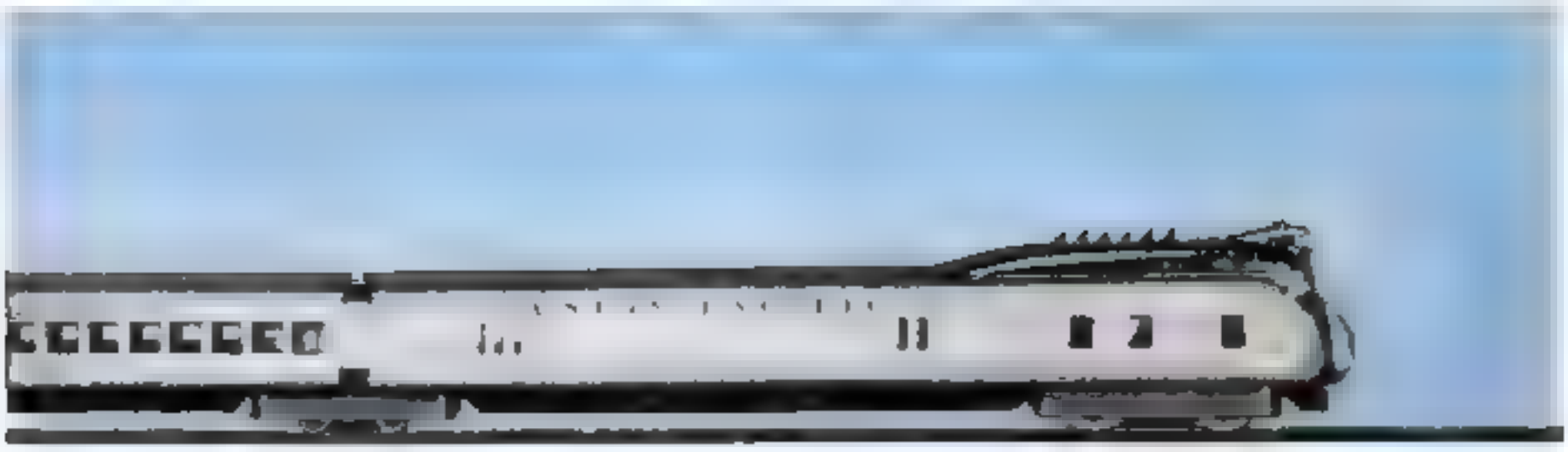
The first operation is to lay off all the car lengths and do the necessary boring for the shields (articulating pivots) before cutting apart. Use an expansion bit, if available and be careful that the hole is not bored all the way through the roof. The locomotive is 18 in. long, the middle car 15 in., and the rear car 18 in. Mark off the center lines carefully at the dividing points.

The roof and floor lengths are not cut off square, but slope back from the center lines toward the sides so they appear slightly pointed when one looks down at them. This leaves a gap at the sides to enable the cars to turn when taking curves. This gap is closed by the turned wooden shield that serves as a pivot. As you have already noted in the detail drawing of the roof and floor sections, they are of different widths, therefore the amount they must be cut back at the ends will be different on each to give the same angle.



It is best to finish the roof hole with a gouge and chisel. A 1/16-in. wall should be left around the roof to cover up the shield. Use a fine-toothed saw for cutting the pieces apart so little will be wasted in the kerf.

Next cut the recesses or clearance spaces on the underside of the floor pieces for the trucks. Do this at both ends of the middle car, at the back end of the front car, and at the front end of the rear car. The dimensions are given in a detail drawing, and the gen-



eral shape can be seen in the photographs. Also cut out a similar recess for the rear truck. The center of this is 14 in. from the center of the front end of the rear car.

Make four hinge bars or plates as shown from brass, 1/16 by ½ by 2 in. Drill a 3/16-in. hole at one end for pivoting, and five or six small holes for the mounting screws. Mount these plates on the underside of the bottom in the clearance spaces formed for the trucks. The hinge plate on the rear end of each car is set in a recess or mortise 1/16 in. deep, but the one on the front end is mortised in ⅛ in. deep. This permits the hinge plates to rest one above the other and to keep the cars level when joined. Be sure that these plates are properly centered or the cars will not pivot properly.

The pivot shields, shown in the drawings at the bottom of the facing page, are turned on a lathe from hardwood to the dimensions shown. The top of the shield is rounded to fit the contour of the hole that has been bored and chiseled in the roof. No great accuracy is necessary; in fact, the shield should fit loosely in this hole and in the one in the floor so it will not bind. Drill a 3/16-in. hole through the center of the shield from top to bottom for the pivot rod. Counterbore the top slightly to form a recess for the nut that will hold the pivot rod. The pivot rod is ⅛ in. in diameter and threaded at both ends. Solder a nut at the bottom end. Make two collars from 3 16-in. outside diameter brass tubing to a length long enough to support the trucks at the proper distance from the shield.

These little collars serve also as sleeves for the hinges plates, that is they fit within the 3 16-in. holes drilled in the ends of the hinge plates.

Assemble each car framework next. The bottom of the three cars is to be ⅛ in. above the top of the rails, and the roof 3 in. above the rails, as shown at the left. The space be- *(Continued on page 90)*

The shapes to which the roof and floor sections are planed. This also shows their positions in the car

The left-hand side of the train. The outline of the sidepieces is shown by the heavy line. A small rod banding strip is nailed along this line

Small Table Built in Modern Style

THIS small modern table for use in the living room or library was constructed entirely of pine with black walnut inlays, but maple, birch, or any light colored hardwood will give an even more satisfactory and durable piece of furniture. The end shelves are for holding books.

The mortise-and-tenon joints, with the exception of the three front rails, are designed so that they can be made with the circular saw. Grooves for the inlays can be made by the same method. Cut the inlay strips slightly wider than the grooves and bevel each edge slightly so that it will be a drive fit, thus obviating the necessity of clamping them when they are glued in place.

The two ends of the framework are glued, clamped and allowed to dry. Then assemble them with the front and back, and test with a steel square to be certain that the table is square. If necessary, insert one or two temporary diagonal braces within the frame and leave until dry.

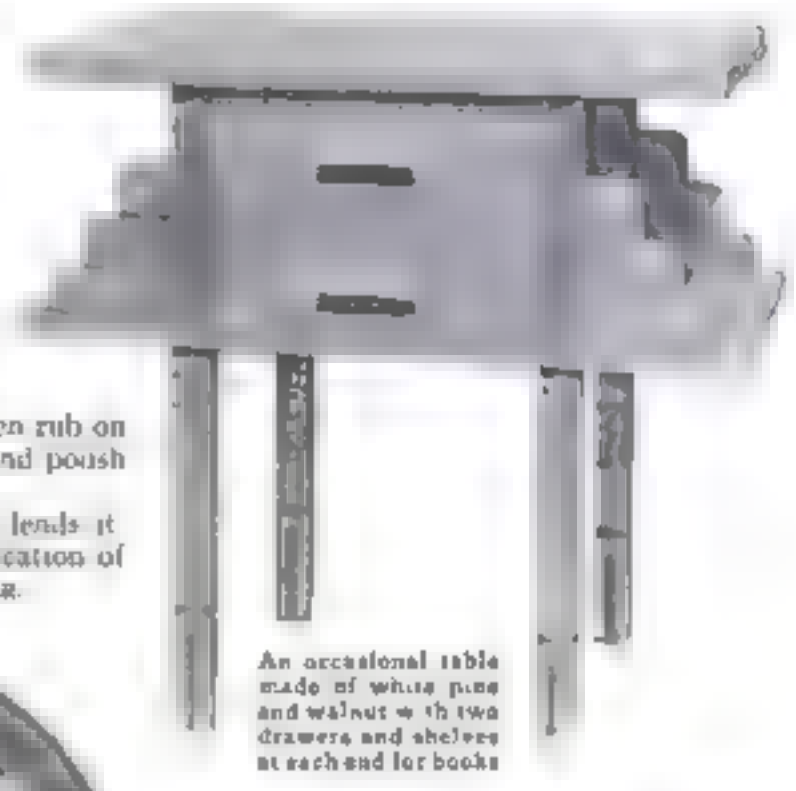
The shelf ends are glued in their respective mortises and pinned with two ½-in. hardwood pins. The drawer runners and bookshelves can be built in next.

Then make the drawers. The sides can be joined to the fronts by a simple rabbeted joint but a dovetailed joint is better.

The top is glued up to the proper width and a cut is made with the circular saw about every 2 in. on the back. These cuts are about three fourths the thickness of the wood in depth. They counteract the tendency of the wood to warp. After the edge strips are glued in place fasten the top with four screws driven from the underside.

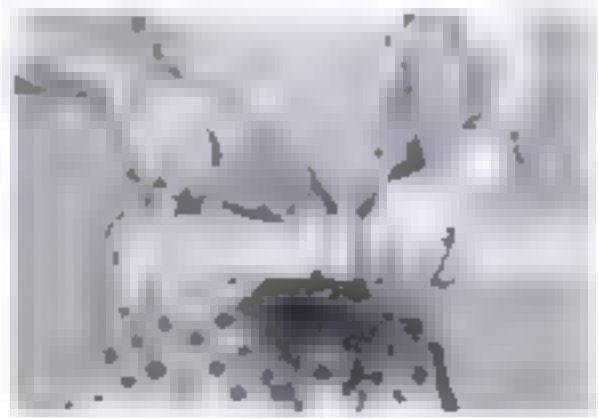
Shellac and wax make a satisfactory and serviceable finish. The shellac—either orange or white, depending on the color desired—is applied in thin coats each coat being allowed to dry for twenty-four hours. Sand each coat with worn sandpaper. Apply three or four coats and then rub on a light coat of any good wax and polish with a soft cloth.

The design of this table also lends itself particularly well to the application of colored lacquers.—ROGER MOYER.



An occasional table made of white pine and walnut with two drawers and shelves at each end for books

If the joints are well made, a woman can put the framework together—and actually did in this case which the author snapped the photo



Strips of walnut are glued in grooves cut in the legs and lower photo a mitered edging is mitered and glued around the top of the table

The shoe-shining outfit is easily carried with two hands; polishes, cloths, brushes

LARD TUB HOLDS SHOE POLISHES

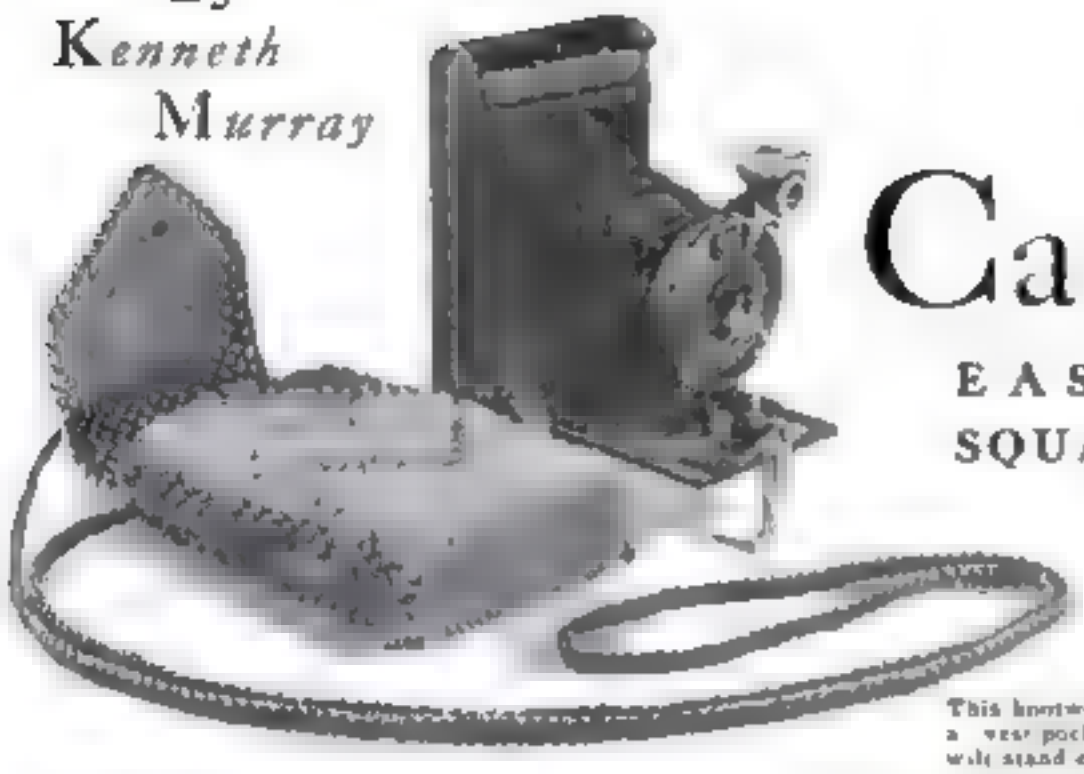
A STURDY shoe-shining stand can be constructed from a small wooden lard tub. Clean the tub thoroughly by scraping and a liberal application of cleaning solvent. With a saw, cut from between the bands about one-third the staves to form the drawer front. Next construct the drawer, using the sawed-out stave sections for the front. These should be bound together, inside and out, at the top and bottom with strips of tin or brass fastened with brass bolts or stove bolts. The original lid of the tub is replaced and nailed. With the tub inverted in its new position, the staves below the drawer front must be bolted to the band crossing them.

A shoe form is next cut from a piece of soft pine, mounted on a block at an angle of 15 deg., and placed upon the small end of the tub. The carrying handle is then transferred to the small end. Sandpaper the bands and wood lightly, apply dark oak stain followed by a coat of clear varnish, and add a drawer knob.—H. A. CLAYTON.

By Kenneth Murray

Durable Camera Case

EASILY MADE WITH SQUARE-KNOTTED CORDS



This knotwork case for a vest-pocket camera will stand endless wear

THIS fine-looking and very durable case for a vest-pocket camera is made merely by tying simple square knots in a number of lengths of strong cord. Cameras of other sizes can be accommodated by altering the measurements. Regulation knotwork cord, which can be had in many colors, may be used, or strong fishline. If the case is to be a gift for a woman, heavy silk cable cord is appropriate

The case illustrated was made in blue, with brown sides, carrying strap, and trimming. To start, cut a blue outline cord 2 ft. long, and twenty-two blue working cords, each 12 ft. in length. In addition, you will need two glass pushpins and the usual knotwork hook (fastened at your waist to hold the filler cords).

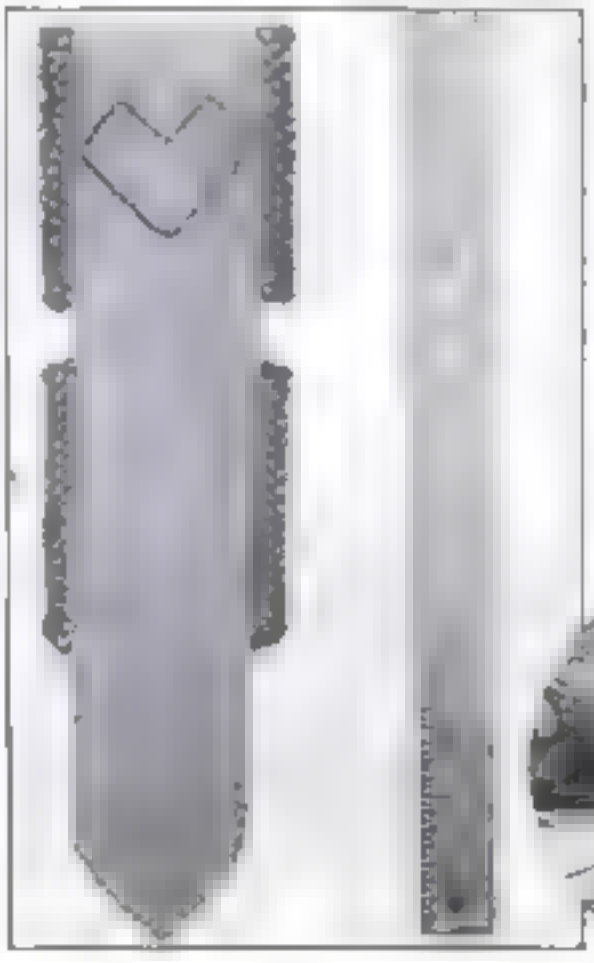
Find the middle of the outline cord (so called because it remains on the outside edge throughout) and, over it, double-loop the middles of two working strands This leaves four cords hanging down Secure the two on the inside in the hook. and with the two on the outside make a square knot. Fasten the knot down to the table top with a pushpin and let the outline cord hang down on either side in the shape of an inverted "V." This forms the shape of the flap for the camera case

The method of adding more cords to the outline cord is shown clearly in Fig. 1. One is added on each side for each row of square knots made across the flap. When all of the working cords have been added, proceed to knot a straight strip for thirty-five rows. (Continued on page 92)

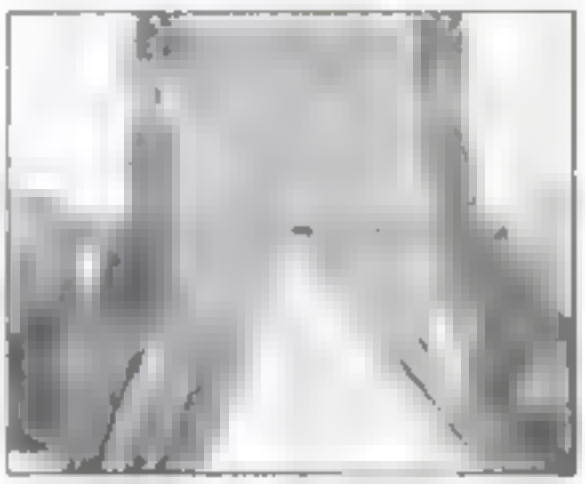
1 The case is started at the point of the flap Added one doubled cords are then looped on the outline cords which are shown at each side. until the flap is the desired width

2 How the strip is widened to provide the sides for the case, *At right* The extra cords added over the outline cord *At left* The outline cord is tied in with half-hitches

Below is shown the strip when all the knotting has been completed The dimensions can be found by comparison with the ruler but



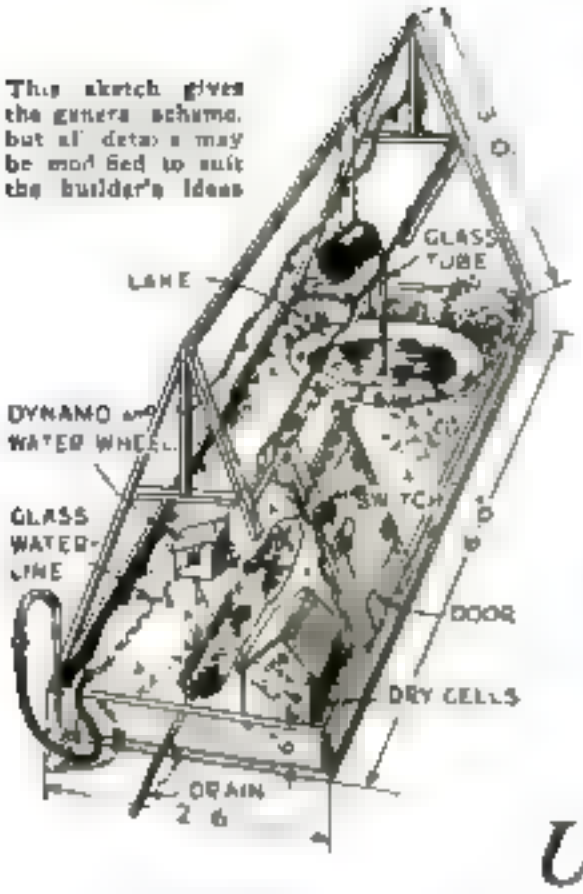
3 The right width to make the knotwork strip can be found by laying the camera over it Absolute accuracy is not necessary as the finished strip can be stretched to a certain extent

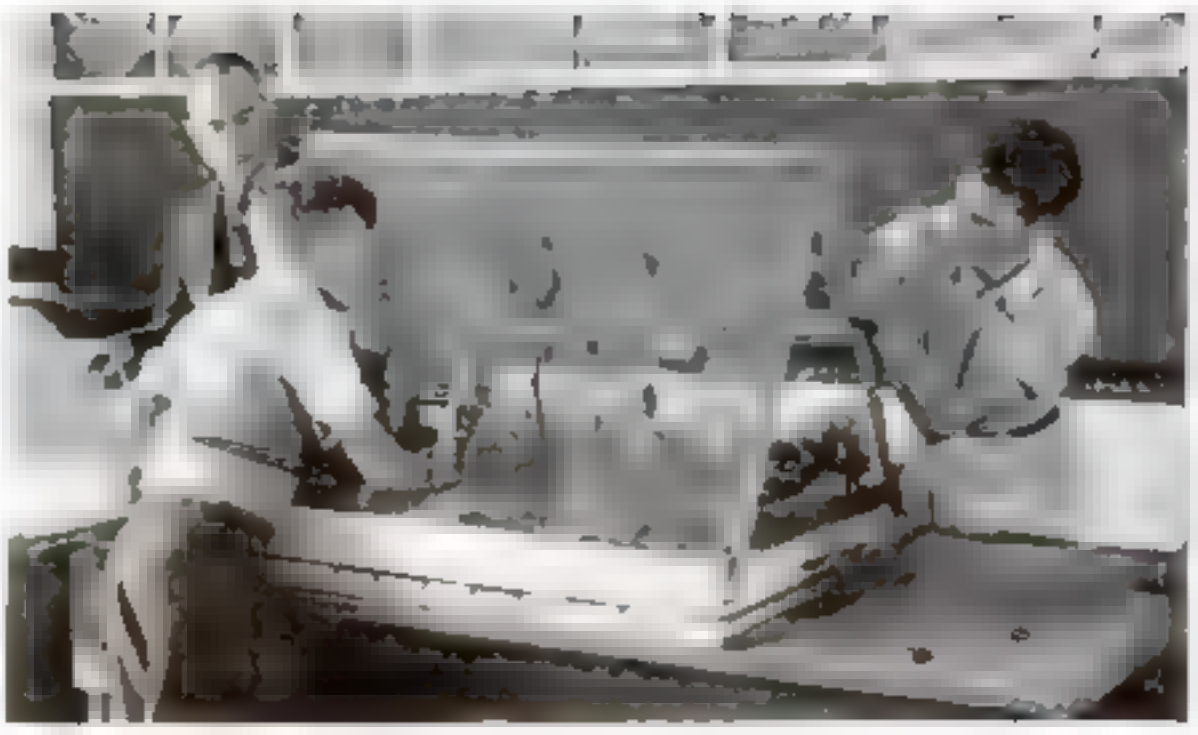


4 To start the design for ornamenting the front of the case, the cords are knotted into an inverted V and a loose cord of contrasting color is tied to the two middle cords

5 The new cord is then half hitched around each free cord in the middle section to form the pattern

6 When the design has been finished, the loose cords are knotted on the back, [illegible]





UNIQUE Terrarium *and* Aquarium

HAS MAGICALLY FLOWING WATER SYSTEM

End view showing glass supply tube which is concealed by the falling stream of water

A COMBINED terrarium and aquarium, illuminated by a small lighting plant, can easily be made as shown in the accompanying illustrations. This one was constructed by the boys in the science department of the Maxton (N. C.) public schools.

A cement lake provides the aquarium, and the overflow of water operates a water wheel in a cement channel leading out from the lake. The lake is fed by a magic water system. A glass tube leads from a near-by faucet in the laboratory and comes up through the center of the lake into the suspended tank. The pressure forces the water through the glass tube into the vessel from which it overflows and runs down over the side of the glass, thus concealing the tube.

The glass feed pipe is laid about 1 in. under the soil from where it enters all the way across to the lake. Enough soil and plants are placed in the bottom of the lake to make it suitable for the growth of any small plant or animal. In fact, the entire structure inside is built on a soil foundation about 5 in. deep, thus making it possible to grow plants of several species. The plants are inhabited by various living insects and small animals. One large dead plant is planted in the center, and to it many insects in the pupal stage are attached.

The power and lighting system consists of a revolving water wheel, generating and power houses, No. 18 copper insulated wire, and five flash-light bulbs. Four of the light bulbs are soldered to the wire and suspended above the lake and canal. The fifth light is installed at the switch. Concealed dry cell batteries furnish power for the lights. This power, however, appears to come from the dynamo attached to the water wheel.

A Pelton water wheel is used. This was constructed by laying a ⅜-in. tube 12 in. long in the cement from the lake to the water wheel with a 3-in. drop. The tube ends in a nozzle near the wheel in order to throw the water with greater force. This arrangement makes it possible to operate the power system with a very small amount of water. The water needed to supply the necessary change in the lake is sufficient to operate the water wheel continuously.

The entire system is screened in to prevent the escape of insects and some of the water animals.—Ernest D. Hancock.

GUMMED STENCILS FOR SMALL DESIGNS

WHEN stenciling small designs on finished woodwork, it is almost impossible, with the usual stiff stencils, to make the design clear and sharp at its edges. It is better to make the stencils of lightweight paper that has been shellacked and then coated two or three times with clear rubber cement. They can then be pressed tightly against the wood and will remain until peeled off. The stencils may be used indefinitely.

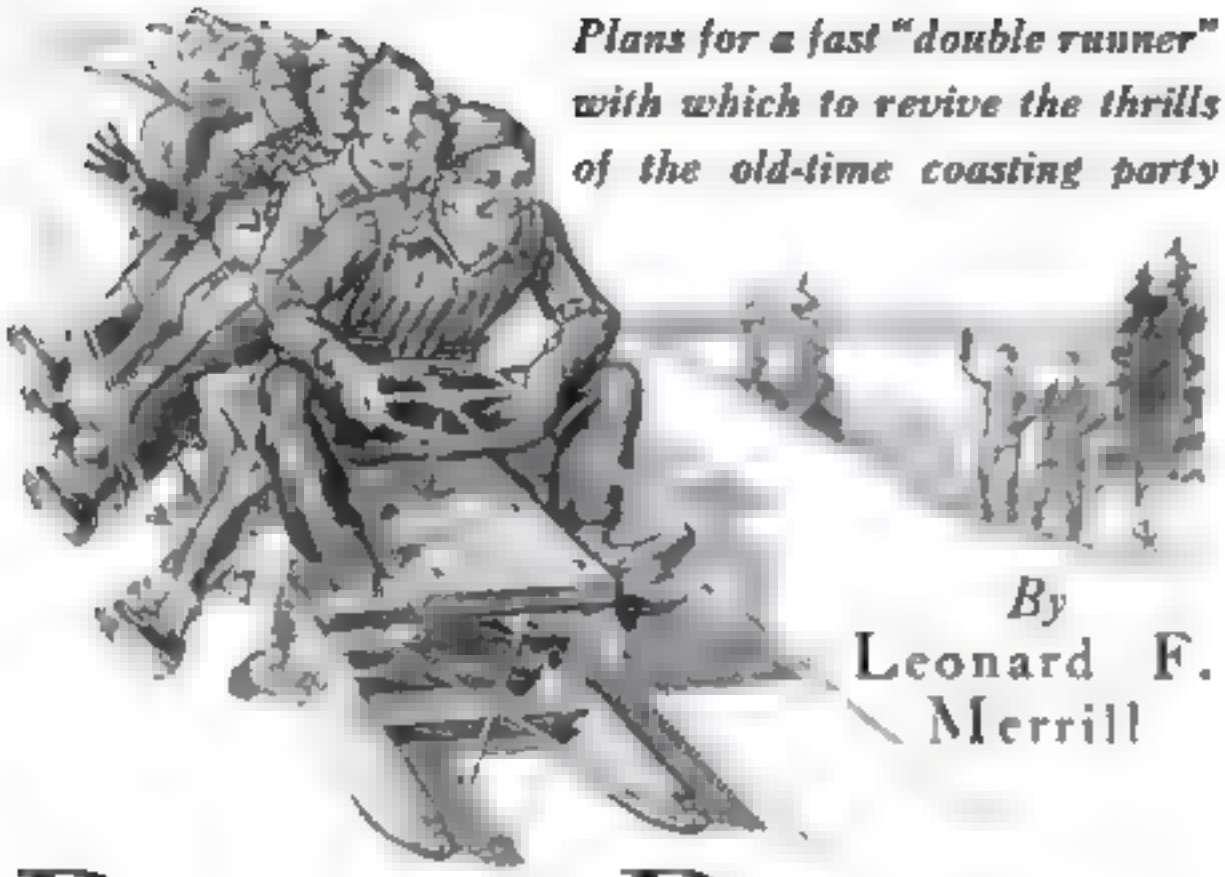
The rubber cement can be purchased in tubes or tins, or it may be made by adding raw rubber to benzole. This, however, requires several days to become thoroughly dissolved.—George S. Greene.

Stencil made of paper that has been shellacked and coated on the back with rubber cement

FLATTENING PHOTOS

PERFECTLY dry glossy photographs are likely to crack if straightened out under a ruler in the usual manner. The possibility of cracks can be avoided, however, if the backs of the pictures are first gone over with a damp (not wet) sponge.

Prints soaked in a weak glycerine solution before being ferrotyped will peel off the plates without curling or leaving drying marks.—C. L.



Plans for a fast "double runner" with which to revive the thrills of the old-time coasting party

By Leonard F. Merrill

Bobsled Building

A BOBSLED, ripper, or double runner—call it what you will—provides fine winter sport and requires only a little snow, a hill, and a congenial crowd to give no end of thrills. There was a time when a pair of hand sleds suitable for use in assembling a bobsled could be bought, but that day is past, so it will be necessary for us to make our own sleds, as well as the rocker, turntable steering gear, and seat.

Materials. Hardwood—1 pc. 1 by 4 in. by 14 ft., 1 pc. 1½ by 2 in. by 7 ft., and 1 pc. 2 by 3 by 16 in. for sleds, 1 pc. 2 by 4 by 26 in. for turntable; 1 pc. 2 by 7 by 36 in. and 1 pc. 3 by 4 by 14 in. for rocker; 1 pc. 1 by 2½ by 20 in. for footrest.

Spruce—1 pc. 1½ by 12 in. by 11 ft. for seat.

One spool (either wood or metal) 3 in. long, 5 in. in diameter, with ⅜-in. hole for the shaft.

A discarded auto steering wheel with piece of shaft 12 in. long.

Flat iron—18 in. of 1/16 by 2 in. for turntable brace and steering-gear support.

Round iron—20 ft. of ½-in. round iron for braces and runners.

Two pulleys ⅜ by 1 in. (with screw eyes) for steering gear.

Manila rope—8 ft. of ¼-in.

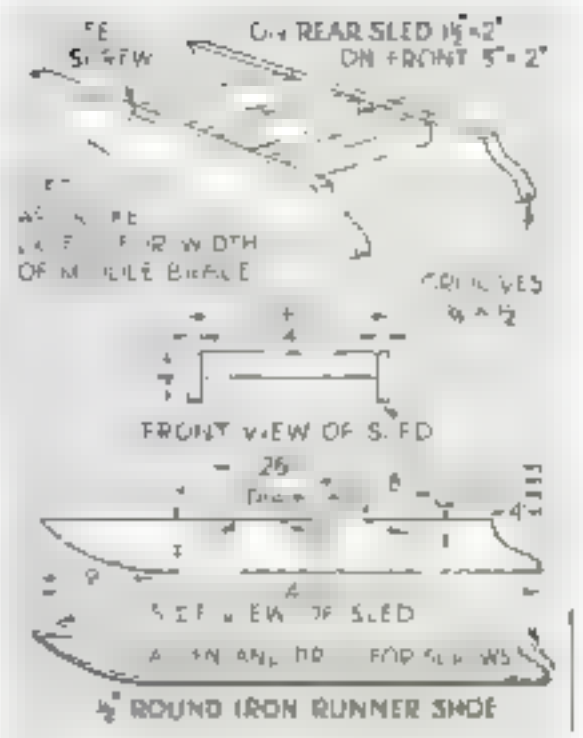
Flathead iron screws, 24 of 1-in.

Carriage bolts: 6—2½ x ¼, 2—3 x ¼; 4—3½ x ⅜; 4—4 x ⅜; 2—6 x ⅜; 1—10 x ½. Flat iron washers for all bolts.

If running boards are to be added: 2 boards 4¼ by 35½ in. by 10 ft., 8 ft. of ½-in. round iron, bolts for the braces and boards.

Tools. Usual woodworking tools and back saw, drill, countersink, center punch, machinist's hammer, and an anvil or suitable substitute.

Method. The two sleds are made first. They are alike except for the middle brace of the front sled, which is twice as wide as the other two braces. Lay out and cut one runner on 1 by 4 in. board. Use this as a pattern for cutting three more. Bore 1-in. holes for ends of wooden braces, spacing centers 1 in. below top of runner and 10, 18 and 26 in. from rear end.



How the sleds are constructed. Note that the front sled has a middle brace 3 in. wide

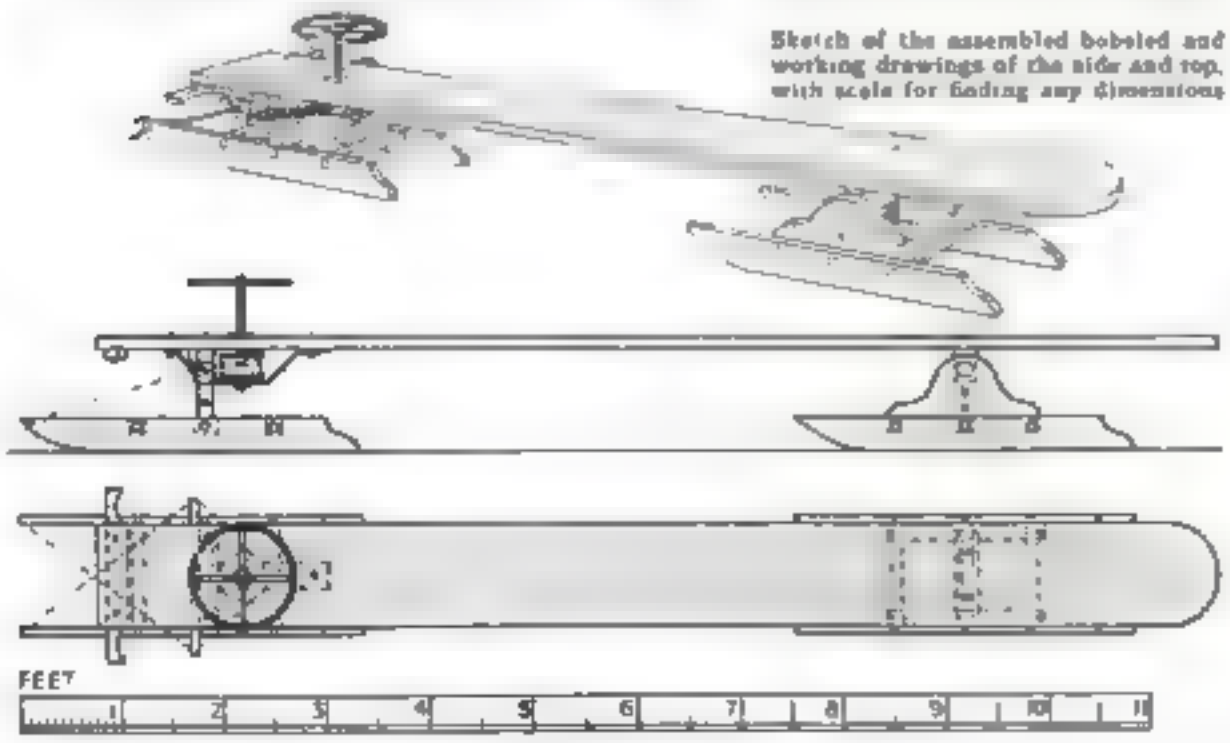
To insure uniformity, clamp two runners together and bore holes at same time.

Cut five wooden braces from 1½ by 2 in. by 7 ft. piece. If lathe is at hand, cut each 16 in. long and turn 1 in. on each end down to 1 in. in diameter; otherwise cut 14 in. long, bore a 1-in. hole in each end about 1½ in. deep, and use a hardwood dowel. In the latter case, both ends of the dowel will have to be held in place with a screw. If the ends have been turned, only one screw is needed through the runner into the brace. The middle brace on the front sled is similar, but 3 in. wide.

Lay out the turntable as shown, being sure all measurements are full. The lower half is bolted to middle brace of front sled with two 3½ by ⅜ in. bolts. Find the exact center of this half of the turntable and bore a ½-in. hole through it and the brace to receive the lower end of the 10 in. bolt.

For the rear sled, lay out two rocker supports on the 2 by 7 in. piece. Locate center of hole before cutting. When both supports are cut, clamp them together and bore holes for the rocker journal. This journal must be either turned down on a lathe or else carefully worked down with a chisel. It is not in the exact center of the 3 by 4 in. crosspiece, but ⅛ in. below center horizontally and on center vertically. The fit should not be loose, neither should it bind. Four 4 by ⅜ in. bolts fasten the rocker supports to the sled. Clamp the supports to the braces to prevent slipping, and bore holes through both at once.

Remove turntable, rockers, and cross braces from runners. Drill and countersink a hole for a 1-in. screw from the top of the runners into each cross-brace hole. Turn runners upside down and cut a groove ½ in. wide and ¼ in. deep the full length of the bottom. Heat the end of a ½-in. round iron rod and flatten for 2 in. At this end also curve the rod to fit end of runner. Continue curve around entire toe of runner and along bottom. When heel is reached, allow about 2 in. and cut off. Heat the heel end, flatten, and bend to fit around heel of runner. Drill and countersink two holes in each flattened end of iron. Repeat this operation for each runner, then proceed with the general assembly. The iron runners, however, are not *(Continued on page 104)*



Sketch of the assembled bobsled and working drawings of the side and top, with scale for finding any dimensions

PRESSING A RUBBER BULB PROPELS THIS INGENIOUS

Toy Submarine

The completed submarine. Pressing and releasing the bulb through a propulsion tube moves the "sub" forward. *At left:* Diving under a wooden "ice floe"

THIS amusing little submarine can be operated in an ordinary tub or a bathtub full of water. It will move forward on the surface, submerge, travel under the water, and rise again.

The hull is made from a small tin can about 2 in. in diameter and 3 in. long with both ends removed. If such a can is not obtainable, you can make one from the tin of a larger can.

The cone-shaped ends, the conning tower, and the periscope are made as shown. The small tin tubes are formed around a nail of the proper size. The nail is then removed and the seam soldered. The 4-oz. lead weight is suspended 1 in. below the hull, otherwise the boat will be unstable.

The rubber tubing should be as small and light as possible (about ⅛ in. outside diameter) and 3 or 4 ft. long. Tubing such as that used on trick roses is very good. Novelty stores usually have them for sale. If one tube is too short, join two of them together. The bulb that is ordinarily attached to the tubes is rather small, but it may be used if a hole is cut in it. A bulb from an atomizer is better. The valve should be removed and the tubing attached as shown. Other details of construction are made clear in the drawings below.

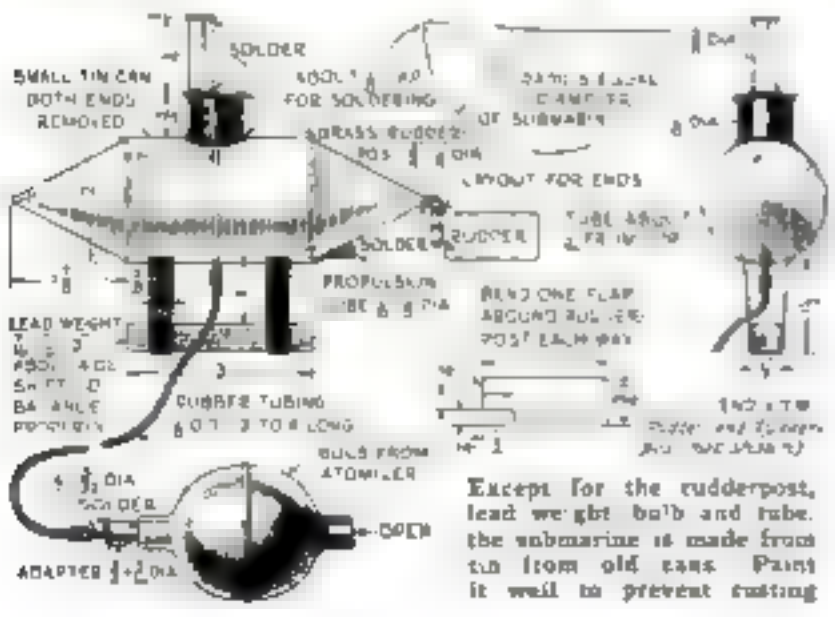
The tube on the submarine to which the rubber tubing is connected extends to the top of the hull, and the only other opening into the boat is the propulsion tube. Thus, to submerge, air is drawn out by means of the bulb and water enters through the propulsion tube at the stern. The vessel will settle lower and lower until finally the periscope goes under. If you wish you may submerge until only the top of the periscope is in view.

To bring the submarine to the surface again, simply pump air in by squeezing the bulb while the thumb is held over its open end. Then, before releasing the bulb, remove the thumb, and before squeezing it again, replace the thumb. When drawing air out, the operation is reversed.

To propel the submarine forward on the surface, set the rudder as desired. Next compress the bulb and draw air out of the boat until the deck is awash. Then press the bulb steadily. As water is forced out of the stern tube, the boat will rise and move forward at a fair rate of speed. Keep your thumb on the bulb opening and allow the bulb to expand, then repeat the operation.

The most interesting trick is to propel the boat forward without rising to the surface. In order to do this, submerge until resting on the bottom. Then force air into the boat until it just starts to rise and move forward, but release the pressure before it has had time to rise to the surface. Allow the boat to sink, and repeat the operation.

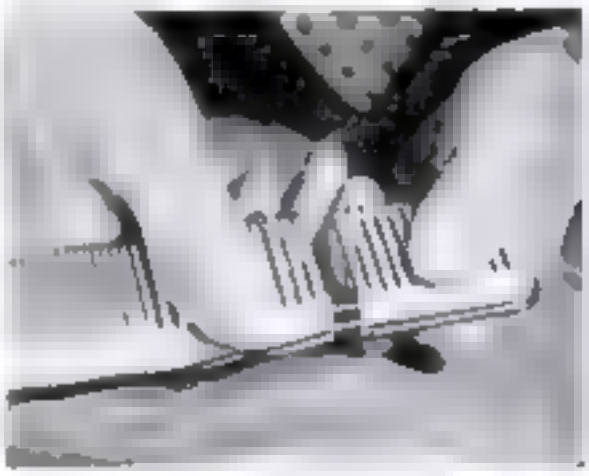
Paint some wooden blocks white as shown in one of the illustrations, to represent an ice floe and you can have a lot of fun trying to pass under the floe without bumping the periscope. If you come to a patch of open water, pump air in very slowly to bring the submarine straight up.—PAUL R. RANNIE



Except for the rudderpost, lead weight, bulb and tube, the submarine is made from tin from old cans. Paint it well to prevent rusting

HOW TO REPAIR BROKEN DRESSING-SET COMBS

VALUABLE combs and other articles in a matched dressing set can often be repaired, when broken, by using two short brass escutcheon pins, brads, or pieces of wire as dowels. Two holes are first drilled in one part of the comb. Short metallic points are inserted temporarily so that when the two parts are brought together marks will be made in the undrilled portion as guides for drilling the other holes. Cut the heads from two short brass brads and use them as dowels. Place a little transparent cellulose cement on both the dowels and the broken edges, and force the parts tightly together. The cement should be allowed to dry undisturbed for several days.—E. A. BOWER



Holes are drilled in the parts, which are then assembled with brass pins and cement

OFFICE STAPLER TACKS LABELS ON WOOD

AN ORDINARY office stapler, when removed from its base, may be used for quickly fastening address tags to wooden crates or boxes and also for tacking up bills or notices. The wire staples are easily forced into the wood and hold the paper or cardboard securely.—ERNEST PEARSON

MOLDINGS MADE ON LATHE DECORATE SERVING TRAY

A serving tray lacquered blue, with sea lapad border in yellow and black

Never Say a Job's Too Hard

SUPPOSE you wanted a tray like this, but did not have a spindle shaper for making the molded edge. Would you give it up? The author of this article didn't. He simply used his lathe for turning the moldings.

ONLY a lathe is needed to ornament the edges of this colorful tray. The segments of moldings glued around the base are cut from turned rings resembling round picture frames.

For the bottom scribe an 11-in. circle, draw eight equidistant radii, and strike arcs of 3-in. radius on a piece of plywood. If a bandsaw is at hand, and several trays are to be made, tack a dozen or more thicknesses of three-ply together with the pattern on top (nails driven into the waste wood), and cut the batch at one time. Sand the faces smooth, sponge with water to raise the grain, and sand smooth again when dry.

For a really fine paint job, brush on two coats of lacquer, and when dry, scrape level with a square-edged cabinet scraper, finishing with spit 6-0 sandpaper used wet. Then give one more coat of color, to be rubbed down, first with the sandpaper, then with pumice stone and water applied with a felt pad.

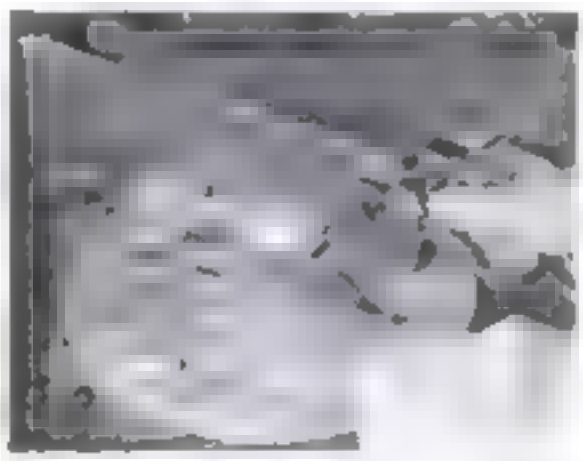
While the bottom dries make the moldings. Mount disks of wood on a faceplate for turning the fronts. It is necessary, of course, to be accurate in turning the profiles, so that the segments will match at the joints. When all are turned saw out the waste centers.

Make a chuck to hold the rings while the rabbets are being turned, and trim the insides. Scrape the rabbets with a ¼-in. chisel. The finished rings can be pried out of the chuck with a chisel pushed in behind at the end grain, since this part is later cut away.

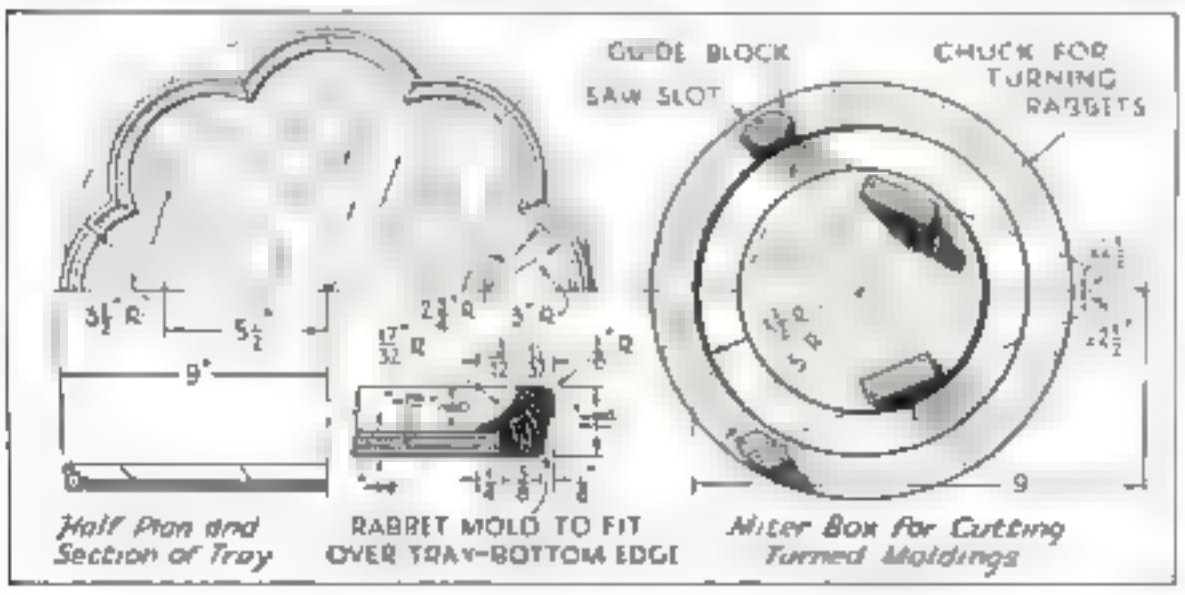
Use the chuck, with the addition of guide blocks, as a miter box to cut the segments. Insert the half-rings with the rabbet out and the grain running the long way.

Scrape the paint from the bottom along the edges, exposing 1/16 in. of wood. If thick casein glue is used, the sections can be pressed in place, and no nailing or clamping will be required. Complete the tray by painting the molding as desired.

The rings are held in a wooden chuck for turning the rabbet and trimming the inside



Six blocks are then added to the chuck to make it into a miter box for the moldings



CORD FOR CRAFTWORK DYED WITH SPONGE

WHEN lengths of cord are to be dyed for ship model making or any form of craftwork, dip one side or end of a sponge in the liquid and draw the cord through this portion by means of a needle. It should pass out through the dry part of the sponge, which will remove all surplus coloring matter. This is a neat, clean method and is particularly useful in dyeing cord for square-knot work, and for coloring or applying a protective liquid to fishing lines.—WELLINGTON KIRK

TINSEL FUSE PROTECTS MODEL RAILROAD

ALL model railways should have their electric current supply systems protected either by a circuit breaker or by a fuse. Circuit breakers, however, cost money, and if the model railway is much used, even the expense of replacing plug fuses becomes quite an item. The illustration shows how to construct a fuse for model railways, that, once installed, can be renewed at virtually no expense.

First connect in the circuit a grid leak clip such as can be obtained at any radio store. Also get a grid leak of the tubular type with metal ends. Any radio service man is likely to have plenty of discarded ones in his scrap box. Remove both metal end caps by applying a little heat, as these are usually fastened with a shellac-like cement. Take a strip of Christmas-tree tinsel or tinfoil a bit longer than the tube portion of the grid leak and put it in so that the ends will be held in place by the end caps. The pressure will insure a good contact. If the fuse blows too easily, fit two pieces of tinsel or a thicker strip of tinfoil.—WALTER FLINT, JR.

The fuse is a strip of tinfoil inserted in an old radio grid leak of the tubular type

Check Your Shop Lighting

WHEN you tackle a job in your home workshop, do you make frequent mistakes, bruise and cut your fingers, and emerge in an hour or two with a headache? If you do any or all of these things, the chances are that there is something wrong with the shop lighting system.

"Oh, I doubt that," you may say to yourself. "Besides, I have a big bulb right over my bench, and the shop looks to be pretty well lighted."

All right, test the light for yourself and see just how good it is. If it is nighttime, stop reading right away and take this magazine to the basement, or wherever you have your shop. Lay it open on your bench so that the chart on the opposite page is in the position where you do most of your work. This chart has been especially worked out by POPULAR SCIENCE MONTHLY to serve as a test of home workshop illumination.

Now lean over until your head is at your normal reading distance from the chart and try to read the smallest type—that in the upper right-hand corner. Then look at the small drawing directly at the left of the type. Can you make out all the lines, distinguish the separate parts and read the dimensions and identifying letters?

If you can do all this correctly and easily, without any special straining, your bench is very well lighted at this particular point. There may be other things wrong with the lighting, such as glare, the casting of violent shadows, and the lack of proper reflectors and shades, but the amount of light certainly is sufficient.

If you don't have much luck with the first sample on the test chart, try the second. Study both the drawing and the accompanying type. If both are easily read the illumination at this point of [illegible] bench is good.

Try the third division of the chart. It can be read comfortably in what may be called "fair" illumination, but this is not good enough for a workbench, especially when accurate or delicate work has to be done, such as fitting furniture joints or making models. Neither is it adequate for working from small drawings of the type published in magazines and books or for studying blueprints that contain fine lines and intricate details.

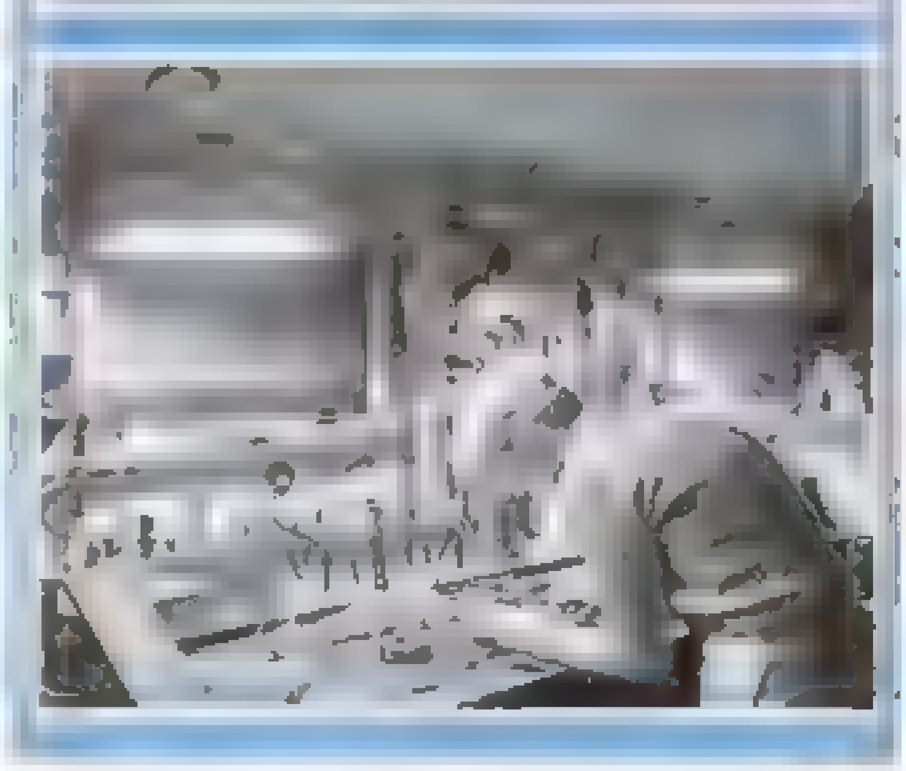
Many home workshops do not have even this degree of illumination. If you find that you have to go as far as the fourth test specimen to make out the letters and figures quickly and clearly, there is no question about the inadequacy of the illumination. It is poor. In fairness to yourself, you should do no further work at the bench until you have improved the lighting.

You may use the chart in the same way at your machines, if you have any, or in other positions in the shop. Provided you are conscientious in using it, the chart will give a rough-and-ready but satisfactory check. For a more accurate and scientific test, lighting engineers use a sensitive instrument known as a "sight meter." Your own lighting company will probably be glad to send a representative to your home with one of these meters to test all your lighting facilities, if you wish.

Plenty of light, properly distributed, is the best insurance against accidents, bungled work, and damage to eyesight in the home workshop, according to J. M. Smith, a Cleveland illuminating engineer.

Most workshops are underlighted, particularly those in which dark-colored tools and materials are used. Engineers measure lighting intensity in foot-candles. In too many shops, the value of the light on a workbench top is scarcely more than 1 or 2 foot-candles, whereas the recommended minimum is 15. Outside sunlight reaches values of many thousand foot-candles, so that you need have no fear of getting too much light. The new so-called "science of seeing," which lighting and vision experts have developed within the past few years, has revealed that it is practically impossible to illuminate a room too brightly if the light is properly distributed.

This movable unit [illegible]



[illegible]

You Will Do Better Work . . . Save Yourself from Eyestrain . . . and Reduce the Risk of Accidents

with New Test Chart

and that increasing the amount of light actually prevents the eyes from becoming tired as rapidly as with lower intensities.

Even worse than too little light is glaring light. A 10-watt bulb, unshaded and suspended in front of the face where its rays shine directly into the eyes, can be painful and will cause partial blindness no matter how much other illumination is present. Glare, then, is to be guarded against. In fact, it is the principal bugbear of modern lighting systems, and sometimes is difficult to eliminate. In addition to direct glare from a lamp, reflected glare from polished metal surfaces must be avoided.

Shadows, too, have to be taken into consideration. In some types of shop work they are necessary to reveal objects in three dimensions, but when most of the work is concerned with length and breadth only, shadowless lighting is preferable. When shadows are desirable, they should be soft and luminous.

"How can I meet all these conditions?" you ask, perhaps thinking it next to impossible to do so.

Take a concrete example: Suppose that you have a workbench 3 ft. high and measuring 3 by 8 ft. on top, and that the room has a ceiling 7 ft. above the floor. This is a good average for basement shop conditions. You desire to light the bench in the most approved manner.

A sufficient amount of light, Smith calculated when the problem was presented to him, will be provided by two 150-watt, frosted-bowl lamps in standard 14-in. R.L.M. domes, spaced 5 ft. apart and 2½ to 3 ft. above the surface of the bench. R.L.M. is a trade designation for the type of dome illustrated, although what it really stands for is "recommended by lamp manufacturers." These lighting units should be placed so that their centers are 6 in. back of a vertical line extending from the front edge of the bench, and 2½ ft. on either side of a line drawn across the center of the bench. They measure about 1 ft. high over all.

The R.L.M. domes are metal reflectors enameled green on the outside and white inside. They are scientifically shaped for the most efficient distribution of light. The porcelain, which is baked on, is easy to clean; and it and the bulb should be kept clean at all times if you want the most light for your money. R.L.M. reflectors are made *(Continued on page 75)*

This chart will show whether you have excellent, good, fair, or poor light in your shop

You will find it a pleasure to work with shop machines that are equipped with their own lights in suitable reflectors. The milling machine above has an adjustable unit costing $1.50 for the parts. It is adaptable to most machines. In the oval is a 150-watt lamp mounted on a swinging arm for illuminating lathe work properly

RIGGING OUR NEW Privateer Model

THE RAKISH LITTLE *Swallow*

By Captain E. Armitage McCann

The author puts the finishing touches on the model of the Swallow he designed especially for Popular Science Monthly. The view in the vise shows the method of rigging the bowsprit

OUR model of the *Swallow*, a privateer of 1812, is now ready for the rigging. We have described the making of the hull, deck fittings, and spars for this smart little topsail schooner in three previous articles.

This type of vessel was the fastest craft afloat at that time. Though very lightly sparred, they were small vessels, so the spars and cordage were lighter than that of a full-rigged ship. This should be kept in mind

As with a real vessel, the first thing to be shipped is the bowsprit. The heel goes through the bulwarks, and the square end is set between the posts on deck. Pass the gammoning (lashing) around the 'sprit and through the hole in the stem about five turns, with cross turns between the 'sprit and the stem.

As there is no bobstay, the bowsprit shrouds come low on the hull (see the rigging plan published last month). The after ends are spliced or seized to bolts in the hull. Deadeyes are turned into the outer ends, connecting with others fastened to the bowsprit at the after ends of the bees

Four thicknesses of cord are required, as indicated in the accompanying list, although this may be reduced to three sizes by cutting out the size marked "C." For sail gear and seizings, use "A" sewing silk. Black cord will be required for standing rigging, and white or light brown for running rigging—that is, ropes which reeve through blocks. Where splices are mentioned you can actually splice the thicker grades or seize the ends back (a seizing is a binding). With the thinner grades, a hitch is sufficient, as a rule.

To set up the rigging, deadeyes are used as shown in a detail drawing near the end of this article. Chain plates made like No. 1 are the most correct; No. 3 is the simplest, and No. 2 is the kind I used as a compromise. It is formed of one ring around the deadeye, squeezed together underneath to lie in the notch in the channel. The bottom link is a link from a piece of chain, also squeezed together The middle link is a piece of wire rove through both and soldered. The deadeyes must lie snug on the channels. A small escutcheon pin holds the lower end down.

Now ship the foremast, being careful that it is in line with the stem and at the right rake aft. For the shrouds take a piece of cord, seize a deadeye in one end, pass the other between the crosstrees, around the lowermast and down again on the starboard side, and seize in another deadeye. Put knots in the ends of pieces of c-cord, pass the ends through the hole in the top deadeyes (facing the left eye when looking outboard), through the corresponding lower deadeye, and so on. Haul them down tight together, but do not fasten. Do the same on the port side. When all four are tight with the mast upright and the deadeyes are at the same level, hitch the ends around the shroud above the deadeyes.

As there are three shrouds to a side, pass the last one up one side and down the other; or, better, make a cut splice and pass that over the masthead.

Do the same at the main, but use only one pair each side

The forestay goes over the forward crosstrees, around the lowermast, and down the other side. The ends go through the bees and are seized tightly to bolts in the hull, close to the bowsprit. If you are showing the hanks (rings) for the foresail, these go on before reeving through the bees. The two parts are seized together above the jib boom and at the top.

The mainstay is spliced around the lowermast head, close under the cap, and is seized back to the eye in the forecap. The preventer stays go around the masthead as for the fore, but in the ends are spliced 3/16-in. blocks connected with similar blocks strapped to bolts in the deck at the waterways. When the foresail is set, the lee preventer stay is slacked up.

The ratlines (steps) are of fine sewing silk, a full ½ in. apart, clove-hitched to each shroud. I use a bent needle for this, working from left to right.

Before shipping the booms, pass a knotted cord through

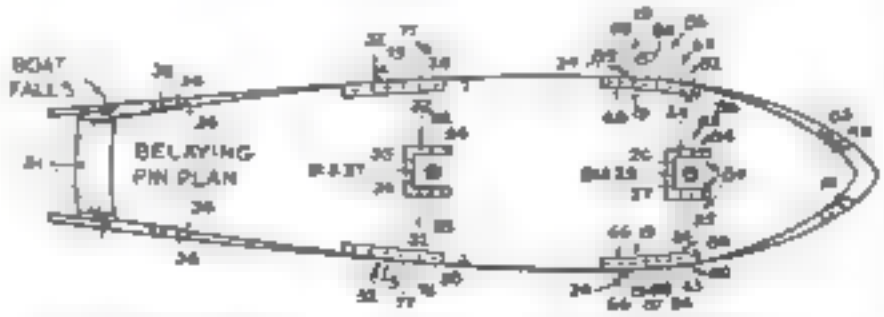


Diagram showing what the belaying pins are used for. Each number represents a line on the main rigging plan published last month

SEE pages 102 and 103 for list of our construction kits.

one end of the jaws, splice in the topping lifts, and seize on the sheet blocks. The seizings pass through the slots in the cleats. Double 3/16-in. blocks are used for the upper, and single for the lower. Put the jaws to the masts, pass the ends of the cords through the other holes in the jaws, and knot them. Reeve the topping lifts through blocks seized under the trestletrees and splice blocks in their ends; through these reeve thin cords, one end of which goes to the bolts in the channels and the other through the outer sheaves in the fife-rail posts.

The fore-sheet block hooks to the ring on the traveler and hitches around its own parts. The main sheet hooks to the ring in the taffrail, each end belaying to a cleat on the knees at the corners.

The foregaff has a double block at the jaws and another to the eye on the mast. The tackle of b-cord reeves through these and down through the inner sheave in the fife rail, to port. The peak halyard starts at the end of the gaff, through a double block at the masthead, through a block halfway out, then up, and down to the fife rail to starboard.

The main is the same except that the peak halyards have two blocks on both gaff and mast, and the sides are reversed. Both have vangs to steady them from swinging. These are spliced or seized around the gaff and lead with a single block and runner to bolts in the waterways. Throat downhauls are needed to keep them in position—from jaws to fife rails. They should each have peak downhauls also.

The jib boom reeves through the cap and has its heel lashed on the cleat on the bowsprit. The martingale boom, commonly called the dolphin striker, hooks to an eye under the cap, has an eye on either side for stays to reeve through and a shoulder at the end. For the martingale and backropes to hold it in position, splice a single cord (a) into the bight of another cord (b), with the eye of the latter just big enough to go on the end of the dolphin striker. Put this on, take the single cord and seize it around the end of the jib boom very tightly, then draw each leg of the backropes back to eyes in the hull and seize, or, better, make eyes in their ends and tighten with lanyards.

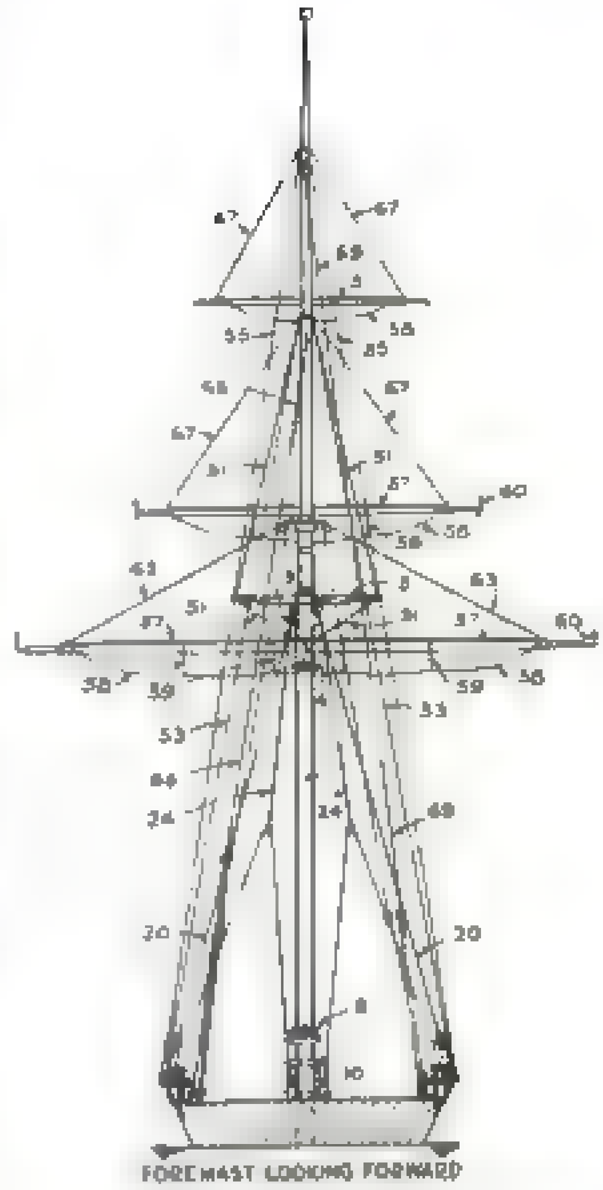
Materials for Rigging and Finishing

CORD: 15 ft. black about as thick as 20-gauge (B. & S.) wire and designated throughout as size a; [illegible] ft. black [illegible] gauge marked b; 10 ft. black and 15 ft. white [illegible]-gauge marked c; and [illegible] white 30-gauge marked d. [illegible] desired, the [illegible] may be used for both c and d. [illegible]
WIRE: [illegible] ft. No. [illegible] magnet wire for foot ropes; 4 ft. No. [illegible] tinned wire for jackstays, etc.; [illegible] ft. No. [illegible] copper for chain plates, [illegible] traveler, etc.
CHAIN: [illegible] in. with from [illegible] to 13 links per inch for cables; [illegible] in. with [illegible] or fewer links per inch for topsail halyards.
BLOCKS: [illegible] 16 in., [illegible] single, 2 double, designated as size [illegible]; [illegible] in., [illegible] single, [illegible] double, size g; [illegible] in., [illegible] single, 3 double, size h; [illegible] in., 3 single, size [illegible] for gun tackles; 1 [illegible] block, marked b; 1 bull's-eye, [illegible] in.
DEADEYES: [illegible] of [illegible]/16 in., 12 of 3/32 in. and 4 of [illegible] in.
TUBING: 4 pc. [illegible] in. inside diameter and [illegible] in. long for cable pipes and pumps.
PINS: 60 common pins [illegible] in. long for making eyebolts, and additional for [illegible]ing and other uses; 20 No. [illegible] escutcheon pins for chain plates and rudder.
ANCHORS: 2 [illegible] stocks [illegible] in. long.
FLAGS: 3 as described.
MISCELLANEOUS: Black, white, and red paint; brown stain, varnish, glue, beads, etc.

The ring for the jib stay must go on the boom before the martingale. This is a ring to slide on the jib boom, with a smaller ring soldered above it. The jib stay splices around the masthead, reeves through the little ring just mentioned, through a hole in the jib boom, and has a sister block turned into its end. This is connected with a single block hooked to an eye in the cap (underneath), the end coming inboard to one of the forward belaying pins. This may be omitted and the stay lead without the ring through the jib boom and through an eye in the martingale boom.

The fore-topmast may go on next. Don't forget the fid, or piece of wire through the heel to prevent its slipping down. Here the stays go on first, splicing around the mastheads and leading through holes in the jib boom, through eyes on the dolphin striker, and back to bolts in the hull where the ends are seized back.

Next, the topmast shrouds, one pair



Supplementary rigging diagram, numbered to correspond with the plans previously given

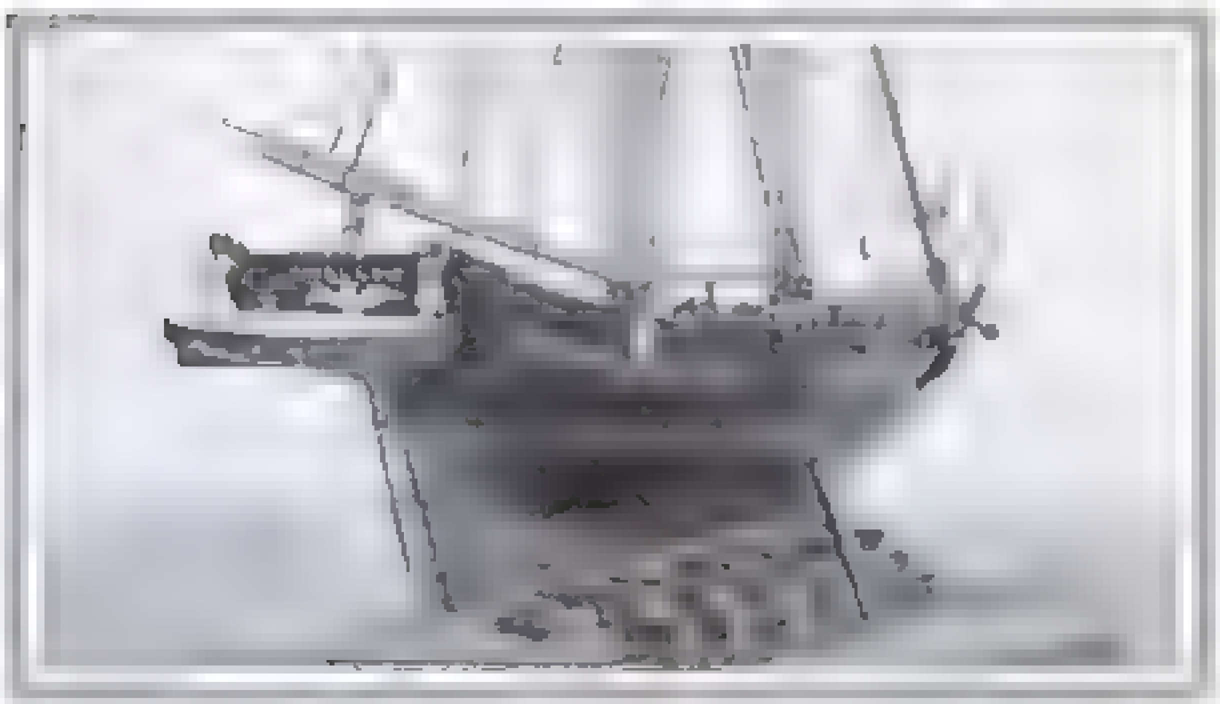
each side, are seized to the masthead. They lead through holes in the ends of the crosstrees and are seized to the eyes in the futtock-shroud bands. These should have ratlines.

The topmast and topgallant backstays come down as the lower shrouds to their respective deadeyes—5/32 in. for the topmast and [illegible] in. for the topgallant backstays.

The main topmast is similar except that there is a long topmast, no topgallant mast, and only one shroud and one backstay to a side. If you are using hoops, there must be some on this mast for the gaff topsail. The stay goes from the masthead to a bolt abaft the main cap.

The lower yard is suspended with a sling and held to the mast with a truss. The former is a long strap with a bull's-eye seized in the bight. This is then passed around the mast and through the the other bight to lie close above the yard. An eye is seized in the bight of another cord with a long end to go over the cap. It is passed through an eye spliced in the short end and seized. The bight of this and the bull's-eye are drawn together with a lanyard so that the yard lies immediately below the futtock band when drawn to the mast with the truss. This is of a-cord with a short end having an eye and a long end that goes around the yard and mast. The end leads on deck to draw the yard close to the mast or slack it as required. These fittings may be much simplified if desired.

At the yardarms the brace pennants are spliced on first, then the topsail-sheet blocks if any, then the topping lifts. A neater alternative is to splice the sheet blocks into the lifts. The forebraces have long pennants (Continued on page 96)



Stern view showing the jolly boat and the type of base used by Captain McCann. The model is set on miniature graving-dock blocks and is shored on each side to take strain off keel

ELECTRIC BANJO CLOCK BUILT AT LOW COST

WITH a few tools and ordinary skill, anyone can make a beautiful electric banjo clock. A suitable movement may be purchased or, as in my own case, removed from a small, inexpensive bedroom electric clock.

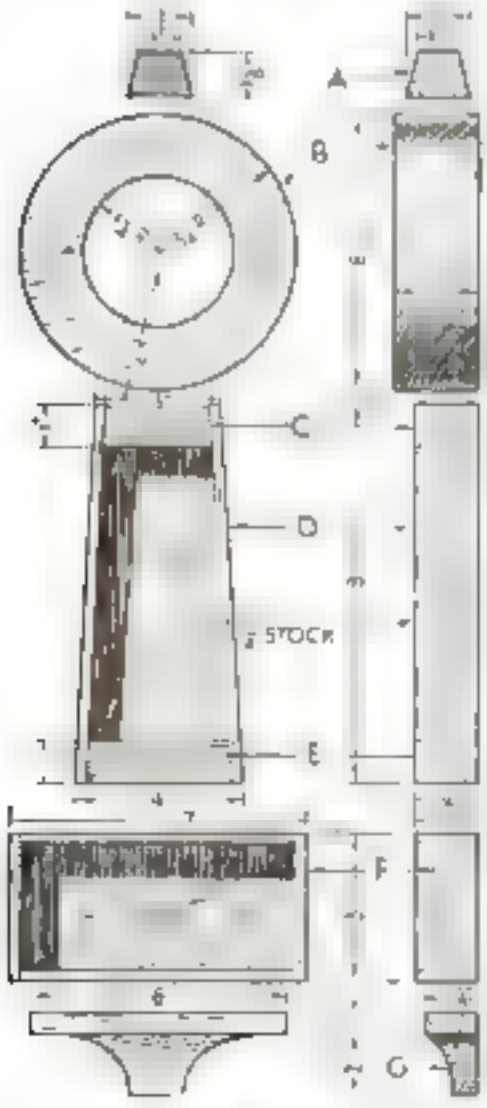
The dimensions of the wooden parts, as given on the drawings, are those I used, but you may make your clock larger or smaller. A slightly larger dial would be desirable, if one could be obtained.

After the various units have been made as shown, fasten *C* to *D* with small brads, then fasten *C* and *D* to *B* by means of a screw and a couple of brads. Have the back of the box and the clock container absolutely flush. Fit *E* inside the lower end of *D* and fasten it with fine brads. Through this sink two screws through the top of *F*. Also carve the lower ornament *G* and fasten it to *F* from the inside. At this stage both *D* and *F* are open in front. Inside these two boxes, glue some narrow strips at the sides, top, and bottom, about 3/16 in. from the edge. Find some suitable colored pictures to fit these open spaces. Back the pictures with cardboard, cut them to shape, and lay them on top of the strips. Cut glass to make a covering for the pictures, making the glass just small enough to fit inside the box and over the pictures. Glue narrow strips of molding around the edges for a frame, mitering the corners carefully.

Now attach *A* and fasten a small gold eagle to it. One can be ordered at any jewelry store, but I carved mine from wood and attached the outspread wings firmly with pins.

Use a plastic wood composition to fill in all the crevices, and sandpaper the case well. Apply a coat of walnut varnish stain, sandpaper it, and repeat three or four times, or use any other type of finish you prefer. Give the eagle a coat of bronze or gilt. Now fit the movement and bring the electric cord out through the back of the clock.

I screwed an eyelet into the back in order to suspend the clock, and also placed two rubber knobs at the back in each lower corner so that the cord could pass down in back. If it is desired to place a scroll on each side of *D*, they can be easily cut from thin brass. I put them on but later removed them, as I liked the general appearance of the clock better without.—JOHN NEIL TIFFANY



How the individual wooden units are made. Glass-covered pictures conceal the front of the parts marked *D* and *F*

Iron Silhouettes

TO ORNAMENT YOUR HOUSE

By H. Silver

WANTED
A Craftsman's Club In Every Town

LeVern T. Ryder (at left), president of the Guild, presents a miniature gavel to the president of the American Hardware Manufacturers Association. *Right*. Shop of Charles L. Hitt

The National Homeworkshop Guild Sets New Goal for its Great Leisure-Time Program

One of ten silver trophies to be awarded in the National Contest each accompanied by $100 in cash

WHERE do you stand in relation to the National Homeworkshop Guild? Are you a member of one of its 128 affiliated clubs? Has a Guild Club been organized in your town?

You owe it to yourself to answer these questions at once. If you have any interest at all in the home workshop hobby—and you must, or you wouldn't be reading this department—you can double the pleasure and satisfaction you get out of it by becoming affiliated with the Guild. It represents the greatest step forward that has ever been taken in behalf of amateur craftsmen. It gives them a chance to get together and compare notes, to learn new methods, to participate in exhibitions and contests, and to do a thousand and one things that haven't been possible in the past. You are simply missing a bet if you don't join a home workshop club.

Now there may not be a club in your locality. You can find out from the list in the right-hand column. It gives all the cities and towns in which Guild clubs have already been organized. If there is a club nearby and you do not know where it meets or who the officers are, send a self-addressed stamped envelope to the National Homeworkshop Guild, 312 Harper Avenue, Rockford, Ill., for that information.

In case you do not find your city or town listed, the thing to do is to get a few of your friends to join with you in starting a club of your own. Any five or more men or women over sixteen years may organize a club and apply to the National Guild for a charter. None of the clubs now in existence has had the least difficulty in getting started or in finding a place to meet, and many of them have doubled and redoubled their membership.

The advantages of becoming affiliated with the Guild have been pointed out in previous articles, but LeVern T. Ryder, president of the national organization, will be glad to outline them in greater detail if you will fill out the coupon at the end of this article. You will also receive a bulletin telling how to obtain names of prospective members, where to hold meetings, how to call and conduct the first meeting, how to prepare a constitution and by-laws, how to choose officers, and how to obtain adequate publicity. Practically all the problems that are likely to arise in organizing a club have already been solved for you. All you need do is find a few congenial neighbors who are interested in some branch of craftwork. It doesn't matter if some of them are without home workshops and have little experience or skill. The Guild is for beginners as well as advanced amateur craftsmen. *(Continued on page 76)*

Akron, Ohio
Amarillo, Texas
Antioch, Cal.
Ashtabula, Ohio
Atlanta, Ga.
Austin, Texas
Beckley, W. Va.
Billings, Mont.
Bloomington, Ind.
[illegible], Conn.
Bristol, Conn.
Bristol, Tenn.
Brookhaven, Miss.
Buffalo, N. Y.
Charlotte, N. C.
Cheyenne, Wyo.
Chicago, Ill.
Cincinnati, Ohio
[illegible], Ohio
Cody, Wyo.
Cooperstown, N. Y.
Creston, Iowa
DeKalb, Ill.
Des Moines, Iowa
Denver, Colo.
Dixon, Ill.
[illegible], Mass.
Eau Gallie, Fla.
Elizabeth, N. J.
[illegible], Ill.
Elmira, N. Y.
Erie, Pa.
Eugene, Ore.
Evansville, Ind.
Fairfield, Ala.
Fairmont, W. Va.
Fargo, N. Dak.
Flint, Mich.
Fort Dodge, Iowa
Fort Wayne, Ind.
Gainesville, Fla.
Galesburg, Ill.
Glen Lyon, Pa.
[illegible], Ind.
[illegible], Kans.
Hornell, N. Y.
Ithaca, N. Y.
Jacksonville, Fla.
Janesville, Wis.
Jersey City, N. J.
Kalamazoo, Mich.
La Grange, Ill.
Lansdale, Pa.
Lawrence, Mass.
Lexington, Ky.
Louisville, Ky.
Lowell, Mass.
Maddock, N. Dak.
Madison, Wis.
Manitowoc, Wis.
Marshalltown, Iowa
Maywood, N. J.
McKeesport, Pa.
Menomonie, Wis.
Miles City, Mont.
Middletown, Conn.
Mobile, Ala.
Moose Jaw, Sask., Can.
Morristown, N. J.
Mount Vernon, N. Y.
New Haven, Conn.
[illegible], N. Y.
New York, N. Y.
Newark, Ohio
North Manchester, Ind.
North Tonawanda, N. Y.
Oakland, Cal.
Oklahoma City, Okla.
Orange, Mass.
Patchogue, L. I., N. Y.
[illegible], Puerto Rico
Peekskill, N. Y.
Philadelphia, Pa.
Port Leyden, N. Y.
Poughkeepsie, N. Y.
Price, Utah
Red Wing, Minn.
Richmond, Ind.
Richmond, Va.
Rochester, N. Y.
Rockford, Ill.
Roseburg, Ore.
Saginaw, Mich.
San Diego, Calif.
Scranton, Pa.
Seattle, Wash.
Sharon, Pa.
[illegible], Pa.
[illegible], Ill.
[illegible], Colo.
Smith Center, Kans.
Snoqualmie, Wash.
Spokane, Wash.
Springfield, Mass.
Stroudsburg, Pa.
St. Charles, Ill.
St. Joseph, Mo.
St. Louis, Mo.
[illegible], Okla.
Sterling, Ill.
Syracuse, N. Y.
The Dalles, Ore.
Topeka, Kans.
Tucson, Ariz.
Tulsa, Okla.
Two Rivers, Wisc.
Vineland, N. J.
Warren, Ohio
Washington, D. C.
Waukegan, Ill.
West Point, Va.
West Springfield, Mass.
Wethersfield, Conn.
Wichita Falls, Texas
Wood Ridge, N. J.
Yakima, Wash.
Yreka, Calif.
Zanesville, Ohio

Members learn rapidly through demonstrations and discussions

The local clubs are busy with their preparations for the National Exhibition and Contest to be held in Chicago, March 25 to 30. One of the larger clubs has already informed the contest committee that it expects to have more than thirty entries ready. Even the smaller clubs hope to enter at least one project in each of the first nine divisions of the contest because that will give them a better score in figuring their total points for the grand sweepstake prize of $100 and a silver cup. Cash prizes totaling $2,000 and ten silver trophies will be given in the various divisions of the contest.

The Guild was organized for the benefit of the amateur craftsmen of the United States, but many inquiries have come from foreign countries. One group of Americans and Englishmen in China asked to be considered for membership. It was finally decided by the national board of directors that clubs organized in Canada would be recognized by the Guild on the same basis as those in the United States. The first club to be chartered under this extension of the Guild's field of activities is the Moose Jaw Homeworkshop Club of Moose Jaw, Saskatchewan, Canada.

LOCAL CLUB NOTES

With its usual progressiveness, the Topeka Homeworkshop Club of Topeka, Kans., has led the way again by being the first local club to publish a bulletin of its own. The first issue is a four page folder called "The Topeka Homeworkshop Club's News Bulletin." It contains the following introductory note:

"The Board of Governors has decided to put out an issue of the News Bulletin as an experiment for the purpose of presenting our meeting dates, place of meetings, and other information and news of general interest to the members. It is planned to substitute this publication for the present method of mailing cards and by calling on the phone. . . . There are a number of members who are very interested in the club, but for various reasons are unable to attend all meetings, and some are unable to get some parts of the meeting through no fault of their own, therefore the Board believes that this plan should be invaluable to these members."

Another editorial tells how the club started about a year ago with twenty members and has grown to approximately seventy-five members, with applications at each meeting.

At a recent meeting of the club, P. A. Van Es discussed the hazards of electricity and explained how the proper installation of equipment saves money on the electric light bill.

Seventeen members and prospective members of the Holton Homeworkshop Club of Holton, Kans., were entertained at a Dutch luncheon by the Topeka Club at the Topeka Chamber of Commerce. This followed an exhibit staged by three Topeka firms, a picture show and a hobby talk.

To obtain old toys that could be repaired for Christmas distribution, the Holton Club offered a prize to the boy or girl who collected the largest number. Both Boy Scouts and Girl Scouts cooperated.

Thomas B. Owens, president of the Homeworkshop Club of Cleveland, reports that the club now has a permanent home—a room about 6 by 12 ft. on the third floor of the Film Building.

"We now have a place to hang our hats," he said, "and our charter is hanging on the wall for the first time. We feel quite jubilant. Our meetings were held in temporary quarters up to now. We can now go after a larger membership and have a more active and interesting club. Our present job is to get some furnishings together. Meetings are being held every week because of the competition announced by Popular Science Monthly. That to me is one of the greatest things, and it has put enthusiasm into all of us. No matter who may carry off the honors of the big show, we hope for its success."

W. M. Garrett, secretary of the Capital Homecraft Club of Washington, D. C., reports that the attendance is very gratifying in spite of the fact that the club is so young. The membership has practically tripled since the first meeting.

The Iroquois Homeworkshop Club of West Springfield, Mass., draws its membership entirely from a large local manufacturing company. It was started by five men in the research department.

"Since we are selecting the members rather carefully at the start," writes R. E. Nest, the president, "we hope to have a 100 percent active membership and to cover many arts and crafts."

The Tri-State Hobbiests Homeworkshop Club of Evansville, Ind., gave a demonstration of wood turning and furniture construction recently in the shop of a local department store. Clinton Hillyard made a floor lamp from laminated black walnut and maple before a group of interested spectators. Among the projects exhibited by members of the club at the same time were a violin constructed by William Perry, a lacquered gun cabinet and walnut coffee table by E. B. Carpenter, secretary of the club; a walnut clover-leaf table and miniature covered wagon with hand-carved oxen by Mr. Hillyard; book ends of elephant design and two other pieces of wood carving by Thomas G. Standing; and a scale model of the *Santa Maria*, by C. H. Ayer.

The Middletown Homeworkshop Club of Middletown, Conn., recently witnessed an instructive demonstration on the use of hand tools by a representative of Stanley Tools, manufacturers of hand and electric tools, who are sponsoring the club woodworking division of the National Guild Contest. The club completed several hundred toys for Christmas.

Lathe, hand-saw, jointer, and planer demonstrations have been given before the newly organized Civic Homeworkshop Guild of Fort Wayne, Ind. The club is growing rapidly and will soon pass the fifty mark.

Although it has not long been organized, the Atlanta Homecraft Club of Atlanta, Ga., has already held one exhibit in a downtown store window. Its members were kept busy just before Christmas making and repairing toys for needy children.

The Greater Lawrence Homeworkshop Club of Lawrence, Mass., broke a record by starting with sixty-six members.

Clubs Just Started

The following new clubs have been organized and granted charters by the National Homeworkshop Guild since the January issue of POPULAR SCIENCE MONTHLY was published:

Fort Wayne Civic Homeworkshop Club, Fort Wayne, Ind.

Greater Lawrence Homeworkshop Club, Lawrence, Mass.

Highland Homeworkshop Club, Louisville, Ky.

Manitowoc Homeworkshop Club, Manitowoc, Wisc.

Moose Jaw Homeworkshop Club, Moose Jaw, Sask., Canada.

North Shore Craftsmans Club, Waukegan, Ill.

Saint Louis Homeworkshop Club, St. Louis, Mo.

Twin City Homeworkshop Club, Sterling, Ill.

These clubs are in addition to those listed on previous occasions. Additional clubs will be announced in these columns as soon as possible after being chartered.

Guest cards like this are useful in following up visitors who may later join the club

FREE BULLETIN TELLS HOW TO START CLUB

WHY not have the honor of organizing a home workshop club in your own community, if one is not already in existence?

The best method of starting a club is outlined step by step in a free bulletin you can have by filling out the coupon below. Send for it at once.

National Homeworkshop Guild
c/o Popular Science Monthly
381 Fourth Avenue, New York, N. Y.

I am interested in the home workshop club idea and wish to know what the National Homeworkshop Guild will do for me. Please send me the organization bulletin. A self-addressed and stamped envelope I am inclosing.

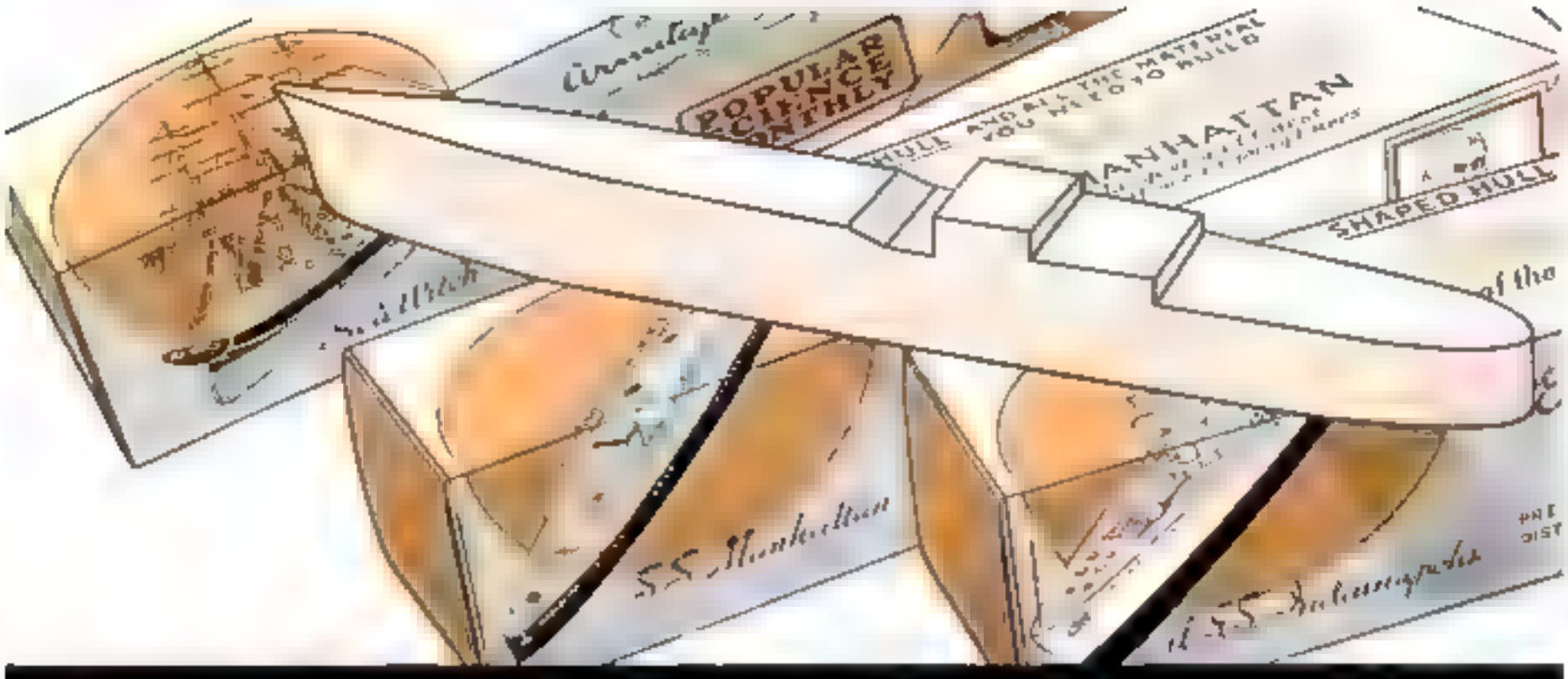
Name

Address

City State

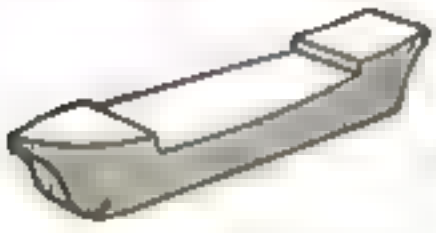
(Please print very clearly)


NO MORE ENERGY?
GET A LIFT WITH A CAMEL!
Whatever the job or strenuous task Camel smokers agree on the delightful energy they get from smoking a Camel! Mrs. William LaVarre famous explorer who knows the necessity of keeping up her energy reserves says: "We took 30,000 Camels with us on our last expedition. Anytime I'm tired, I just stop and smoke a Camel. It wakes up my energy in a minute. Smoking Camels steadily, I find, does not affect one's nerves."
DEEP SEA DIVER
PRO FOOTBALL STAR
CIVIL ENGINEER
LEAF-TOBACCO EXPERTS AGREE
CAMEL
Share This Refreshing Effect That has Meant so Much to Others!
The key to physical stamina, mental alertness, and a cheery outlook is energy! Hence the importance of the recent scientific discovery that smoking a Camel actually turns on your steam! Camel smokers in many walks of life agree upon the benefit and enjoyment they find in Camel's energizing effect. Read what they say and turn to Camels yourself! Camels are delightfully mild—a truly pleasing cigarette. They never jangle your nerves, no matter how many you smoke!
CAMEL'S COSTLIER TOBACCOS NEVER GET ON YOUR NERVES!



BUILD YOUR OWN SHIP MODEL

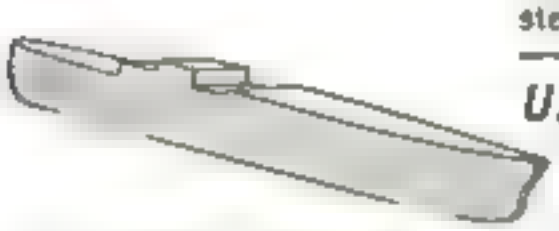
With These New, Improved, Simplified Shaped-Hull Kits



Sugar pine shaped hull—main cuts already made. Easy to finish. Top deck of hull stamped for location of masts, deck houses, etc.

Clipper Ship "Sea Witch" **$1.50** Postpaid

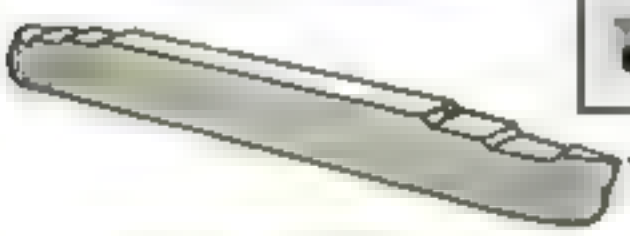
13 inches long—8 inches high. Famous and beautiful American Clipper. Kit contains every part needed including blue print, and pamphlet of instructions. Top deck of shaped hull stamped for location of masts, houses, etc. Kit contains paints, glue, chain, deadeyes, anchors, flags, printed bow and stern name plates. $1 50 delivered



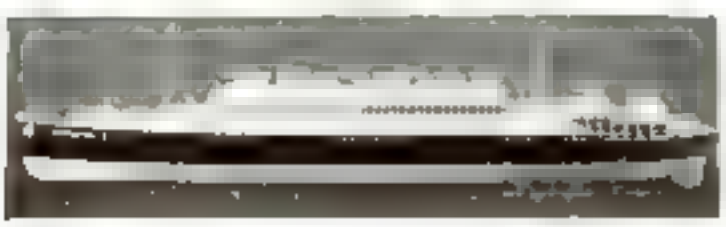
Almost wholly shaped hull of soft sugar pine with all main cuts already made, easy to finish

U. S. S. Indianapolis - - - **$1.50** Postpaid

Complete Kit for 12 inch model of the famous cruiser from which Pres. Roosevelt viewed the fleet. An excellent, graceful, racy model, easy to make with simple hand tools. Kit contains everything needed including paints, glue, anchors, propellers, rudder, blue print, pamphlet of step-by-step instructions, etc. $1.50 postpaid



S. S. Manhattan - - - - - **$1.00** Postpaid



Everything you need to make a 12 inch model of this largest and finest American built liner. A sharp pocket knife is practically the only tool you need. Kit contains paints, glue, blue print, pamphlet of instructions, 40 completely finished life-boat davits, 2 propellers, 2 anchors, 1 rudder. All main cuts in the sugar pine hull already made.

DEALERS!

Write for Terms on These Attractively Packaged New Kits

Model Makers USE THIS COUPON →

Fill out and mail this coupon together with remittance, and the complete Kit or Kits you want will be shipped immediately, delivery paid by us.

POPULAR SCIENCE MONTHLY, 1-35
381 Fourth Avenue, New York, N. Y.

Send me *prepaid* the Kit or Kits checked below, for which I enclose payment

- ☐ SEA WITCH $1.50 Postpaid
- ☐ INDIANAPOLIS 1.50 Postpaid
- MANHATTAN 1.00 Postpaid

NAME _____

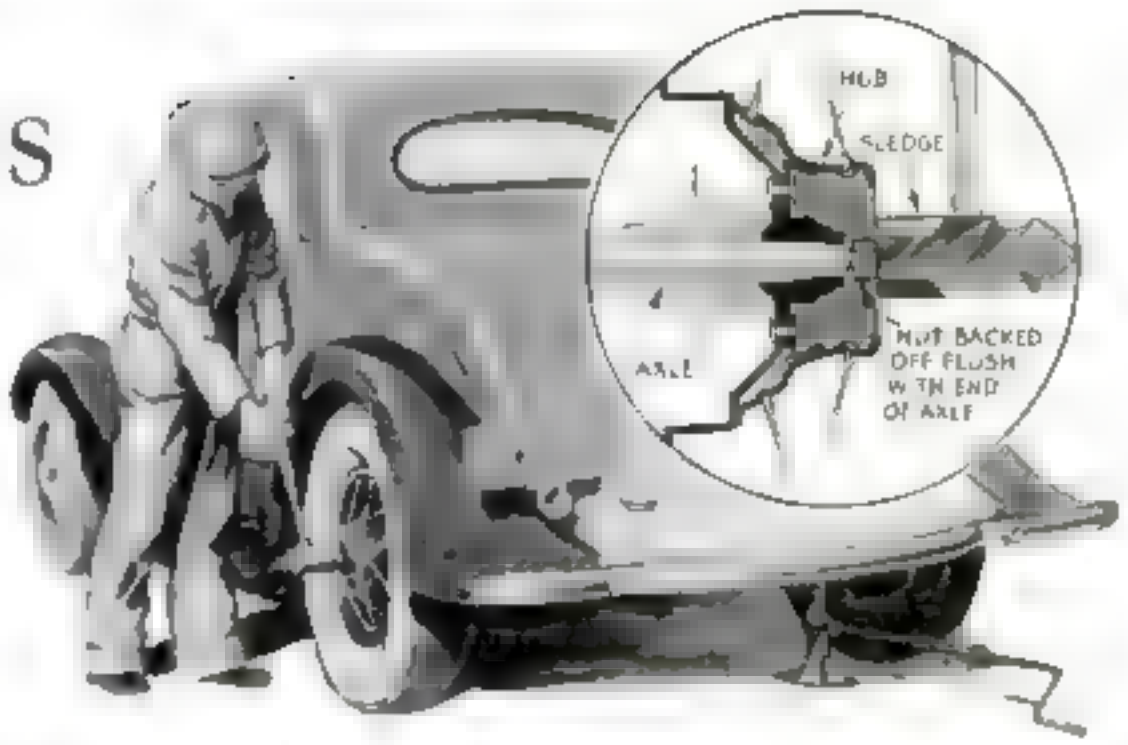
ADDRESS _____

CITY _____ STATE _____

THE MONTH'S BEST

Auto Ideas

Time-Saving Suggestions for Car Owners Made by Our Experienced Readers



A wheel that sticks can be loosened by raising opposite side of car and striking axle with hammer

WHEN a wheel which must be removed sticks so badly that it resists all of the usual wheel-pulling methods, I have found that the following procedure invariably works. First, I jack up the wheel on the opposite side of the car. This places a large proportion of the car's weight on the wheel to be removed. Then, after unscrewing the hub nut just enough to bring it out flush with the threaded end of the axle, I strike the axle end several sharp blows with a heavy hammer. I have yet to find a sticking wheel that won't yield to the pressure and jarring.—A. D. H.

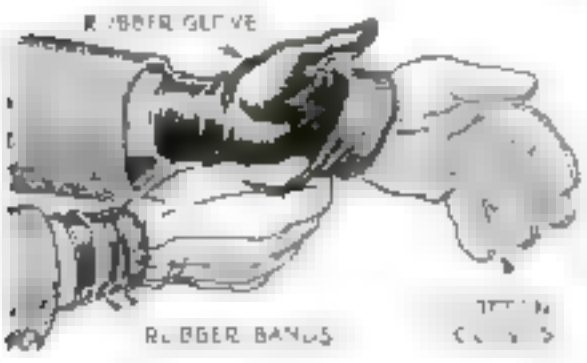
Door Handle Cover

AFTER rain had twice frozen inside of the door-handle lock on my car, I hit on the idea shown in the drawing below. Cutting a four-inch length from a piece of half-inch diameter flexible rubber hose, I placed a one-inch slit in one side, locating it to coincide with the door-handle shaft. In cold weather, when there is the chance that snow or rain will freeze in the lock, I simply stretch the tubing to open the slit and slip it on.—B. S.

Rubber tube, slit and stretched over car's door handle, keeps rain from freezing in the keyhole

Winter Car Washing

IF YOU have ever washed your car in cold weather, you are familiar with the chapped hands that usually result. After trying rubber gloves and finding them cool and much too fragile, the writer hit on the idea of wearing a pair of cheap cotton gloves over the rubber ones. The rubber still prevents the water from chapping the hands but the cotton adds the necessary warmth and protects the rubber.—F. V. A.



Home Vulcanizer That Is Easily Made

NEAT hot patches with ordinary cold cement can be obtained with an inexpensive home tire vulcanizer made from a discarded electric iron, a two-inch square block of wood, a C-clamp, and a two-foot length of iron pipe. First of all, the handle is removed from the iron and the section of pipe bolted in place. Clamps made from strips of iron can be used in mounting the pipe. The assembly then is bolted to the bench with U-bolts in such a way that the bottom of the iron faces up and is about one foot from the bench top. To repair a tire, simply apply the cold patch in the usual way, place the patch face down on the iron, and clamp it firmly with the block of wood and the C-clamp. Turn on the current for three to five minutes and a hot patch will result.—C. A. F.

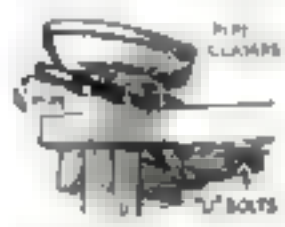
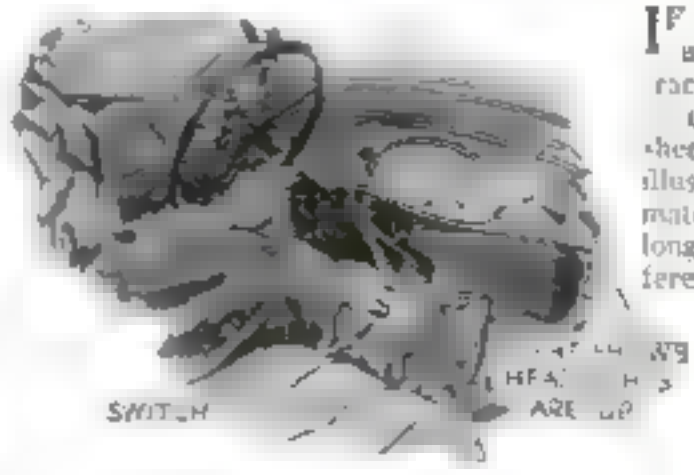


Illustration above shows how to make a home vulcanizer and, left, method of using it is clearly shown

Headlight Pilot

WHEN driving a car equipped with a foot-operated dimmer switch it is often difficult to tell whether your headlights are up or down. To warn me when my headlights are up, I bought an ordinary radio pilot light for fifty cents and mounted it on my instrument panel. The electrical connections necessary were particularly simple, consisting of one wire from the pilot light to the up terminal on the headlight side of the switch.—G. M.



This neatly installed pilot light on dashboard tells the driver whether lights are up or down

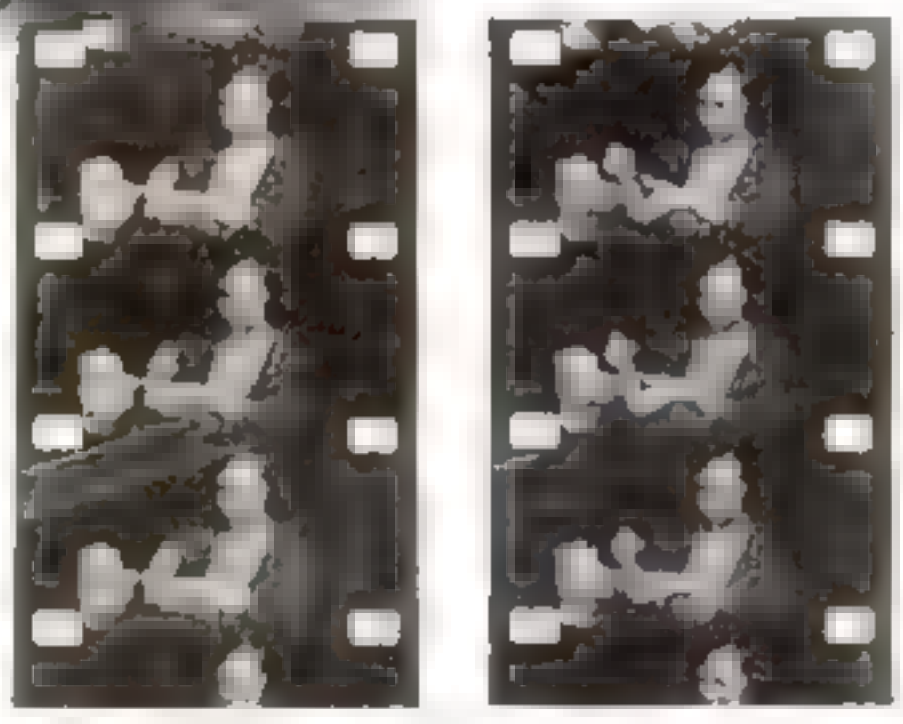
Piston Ring Tool

IF YOU plan to replace the piston rings in your car and haven't a ring contractor, an efficient and inexpensive substitute can be made from a flat strip of sheet iron or brass. As shown in the illustration above, the strip is cut approximately one-half-inch wide and slightly longer than the total compressed circumference of the piston rings. When the two shoulders, formed at the ends of the strip, are pushed together with a large pair of pliers, the loop contracts, compressing the piston ring just enough to allow it to slip into the cylinder. With a little practice, this tool can be used as conveniently as one bought for the purpose.—F. B.

Editing Your MOVIE FILMS

By
Frederick D. Ryder, Jr.

A timesaving rack with spring clothespins for holding short strips of film during the editing



The splice shown at the left is imperfect as indicated by the light area, but that at the right will last as long as the film

THE day you start making your own home movies tell a story instead of being little more than an animated scrapbook, you'll find that your friends will take much greater interest in seeing your pictures. Furthermore, the process of editing your films into a connected story form is easy and fascinating work.

Good film editing starts with the picture taking. No one can edit a story into a reel of film that's worth while if there are no scenes to represent some of the most important things that happened, as well as lively shots of lesser importance to sustain interest in the story and round out the narrative.

On a family outing, for example, you might take a shot of packing things into the car, another through the windshield as the car started, a third as the family debarked at the outing place, several more of the various activities, one of mother and the girls arranging the "eats" and so on. Then you would have enough material to be edited into a connected and interesting story of the whole outing.

In taking movies, never worry about the sequence of the various shots. The primary function of editing is to get them in the proper order by cutting and splicing.

The secondary function of editing films is to note what is missing and figure out ways to supply the deficiency. If, for instance, you forgot in your hurry to shoot any scene of the actual start of your outing, you are quite justified, as the film editor, to give yourself orders, in your capacity as cameraman, to go out and get that scene at the first opportunity. The next time the same members of the family happen to be going anywhere in the car, you can shoot a scene of the start, and this can be spliced into the reel of the outing. If the details are correct, your friends won't know the difference, and in time you yourself will forget that it wasn't the real thing.

Editing your films also means figuring out suitable titles to be made by methods already described (P. S. M. Aug. '34, p. 80). Top-notch editing also requires figuring out all sorts of little explanatory shots that can be made later on. For example, a friend of mine took some pictures on a trip during one of the hottest weeks of last summer. His first thought was to do the obvious thing and include a title reading "the thermometer reading." Then he had a better idea. His camera focused down to a distance of one foot, so he took a large thermometer and made a close-up of it while he held a match a few inches under the bulb and the mercury crawled nearly to the top. He spliced this in right after a title reading "AND WAS IT HOT!" Then he followed it with a close-up of one of the members of the party in his shirt sleeves, fanning himself with a newspaper as the perspiration dripped off his forehead. This shot, too, was taken in chilly weather weeks after the trip. The perspiration was merely water from a dripping wet towel with which the subject's face was mopped just before the button was pressed on the camera.

There is virtually no limit to the possibilities of this particular phase of film editing except your own imagination and ingenuity.

Another man I know has saved every foot of film he has ever taken—bad shots as well as good—on the theory that some of the shots will be useful. Recently he was editing a reel of night scenes, and dug out of his stock a shot his wife had taken of a parade. It had been put in the discard because she had accidentally closed the lens diaphragm all the way, and the film was badly underexposed when considered as a daylight picture. Titled as a night parade, it became an effective addition to the other night scenes!

The mechanical equipment required for film editing need not be expensive nor elaborate, unless you wish to go in for the more costly types of apparatus. The essentials are a film splicer, two hand-crank film-winding heads, some means of examining the film through a magnifying glass, and a way to hold the various strips of film while you are working out the proper arrangement.

A serviceable film splicer can be obtained for about a dollar. You can get a splicer mounted (Continued on page 81)

Another type of rack consisting of hey hooks screwed into an old drawing board. It is best for peg strips

Try a snapshot like this *Tonight*

HERE'S ALL YOU HAVE TO DO

Use Kodak "SS" Film. Set your camera for 1/25 second—Open the lens to *f*.6.3. Put 2 Mazda Photoflood bulbs in lamp A—1 in lamp B. Distances as indicated. Sight the subject, click the shutter—and you've made the picture.

THERE'S A NEW OPEN SEASON FOR SNAPSHOTS. Now you can make *snapshots* indoors—at NIGHT! A new world of picture opportunities . . .

Just use any camera with an *f*.6.3 (or faster) lens, loaded with Kodak Super Sensitive Panchromatic Film. This high-speed "SS" Film does the trick—it's three times as sensitive as ordinary film under artificial light. Two or three Mazda Photoflood bulbs give ample light.

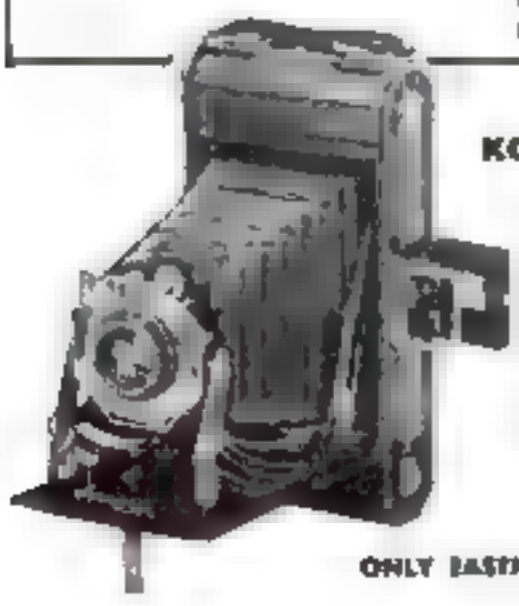
Hold the camera in your hands as you would outdoors, set it for 1/25 second, open the lens to *f*.6.3. Sight the subject, click the shutter. You've made a *snapshot*. *Indoors . . . at* NIGHT.

ALL YOU NEED FOR SNAPSHOTS AT NIGHT

KODAK "SS"—the lightning-fast film, with the screen lightning flashes on the familiar yellow box—the film that, indoors or out in any light, improves picture quality.

MAZDA PHOTOFLOOD BULBS give brilliant light . . . last for two hours, enough for many pictures. Cost but 25¢.

KODAFLECTOR—Inexpensive, efficient . . . makes 3 Photoflood bulbs do the work of 9. Complete with stand, reflectors and cord, $5.



KODAK SIX-20

with Kodak Anastigmat lens *f*.6.3 is ideal for night snapshots. For pictures 2¼ x 3¼ inches, price $17.50. Kodak Six-16, with *f*.6.3 lens, for pictures 2½ x 4¼ inches, $20.

ONLY EASTMAN MAKES THE KODAK

FREE . . . 32-PAGE BOOK

Here's a book you'll want in your library. Complete details about indoor pictures with Photoflood and Photoflash bulbs. Tells you how to make outdoor night pictures of lightning, lighted buildings, fireworks. How to make moonlight photos. Write to Eastman Kodak Company, Rochester, New York.

Name_____ P.S. 2-35

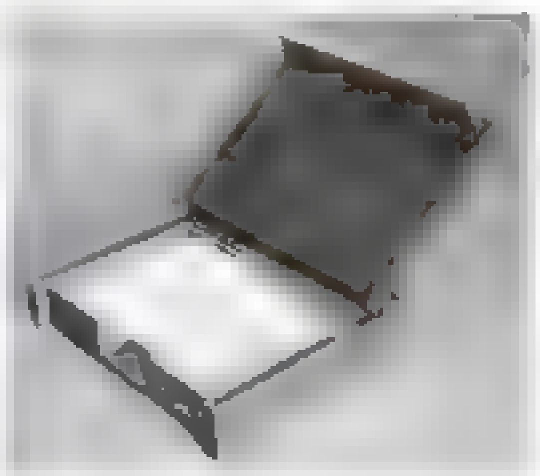
Address_____

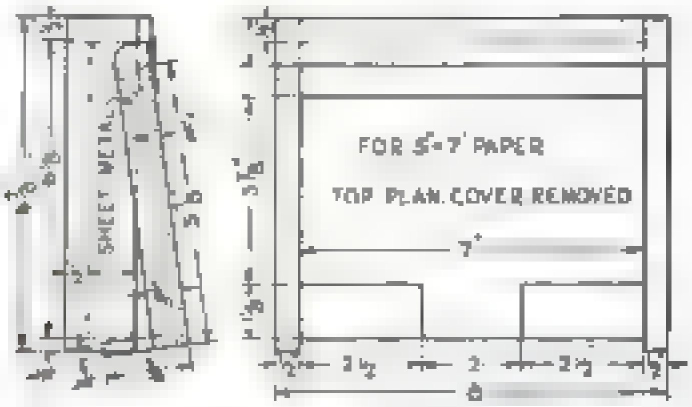
City_____ State_____

BOX KEEPS ENLARGING PAPER HANDY

WHEN a number of photographic enlargements are to be made, all of the same size, a box of the type illustrated below will be found a great timesaver. The effort required to make a few of these boxes to fit the most used sizes of bromide paper will well repay. The sloping sides make the pack of paper splay out sufficiently to enable the top sheet to be quickly grasped. The hinge is a continuous strip of leather.

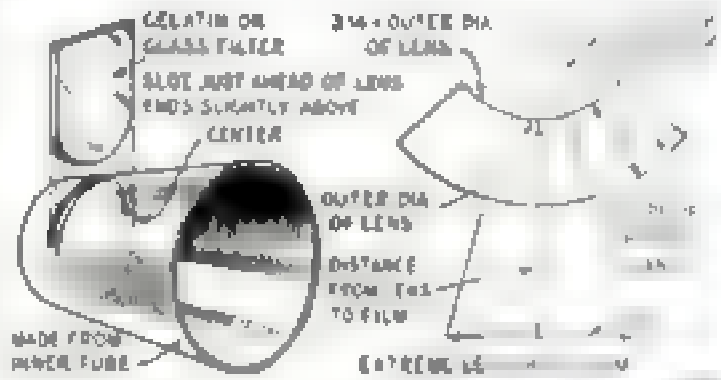
When painted a flat black, inside and out, the box will be found adequately tight, even in full daylight, for a reasonable length of time. Of course, common sense dictates that the darker the place in which it is kept, the better.—Ross Wheelton.





The box has sloping sides so that the top sheet of paper can always be quickly grasped. The lid, which has a long leather hinge, is reasonably light-tight

LENS HOOD MADE FROM OLD INNER TUBE



The hood with slot for holding fi[illegible] lens, and a diagram for laying it

Inserting a filter in [illegible] of the lens hood. Being of soft rubber, the hood can be kept right in the [illegible] pocket

EVERY photographer, amateur or professional, knows that it is essential to keep the sun or any strong artificial light from shining directly on the lens of a camera. A flexible hood for this purpose may be made in less than five minutes from a discarded automobile inner tube. This hood will also serve as a holder for color filters and screens.

To make the hood of the correct shape to afford maximum protection without obstructing the line of sight of the lens, proceed as shown in the diagram. Make a paper pattern for cutting the rubber. Use an ordinary rubber inner-tube patch for cementing the two edges of the hood together; then paint the entire hood a dull black. The smaller end of the hood will fit snugly on the projecting shoulder of the lens and will support the hood firmly in place.

Color filters or screens may be inserted in the hood from the end, or more handily, through a slot cut just ahead of the camera lens itself. The latter method offers an additional advantage in that unmounted, and therefore less expensive, filters and screens may be used.—W. E. Stewart.

PHOTO AWARDS

THE winners of our November 1934, photo contest will be announced in the March issue.

Photographing Shiny Objects

ONE difficult problem for the amateur photographer is to photograph an object with strong high-lights such as cut glass or polished metal.

The most suitable material for taking a picture of this type is modern roll or film-pack film of either the verichrome or supersensitive panchromatic type. Cut film is not quite so good, and glass plates are very poor.

The lighting should be as even and full as possible so as to get the high-lights well distributed and all of the surface well illuminated. The exposure should be a trifle under rather than over the correct value, and the print should be made on soft paper. Be careful, also, not to overdevelop the negative. All details will then be clear.

EDITING MOVIE FILMS

(Continued from page 78)

on a long board with a film wind at each end, plus a magnifier with a light behind the film, for as little as six or seven dollars. Better models of splicers or complete editing units can be obtained at various prices up to thirty-five dollars or more.

Splicing film consists first in trimming the ends true and with the proper overlap. Then the emulsion is scraped from the film edge that faces up, special cement is applied, and the other film is set in place, back down. Pressure need be applied to the joint for only ten or fifteen seconds as the film cement sets very rapidly. When properly made, the joint is even stronger than the film itself

A FAULTY splice that splits apart while you are projecting the film always comes from one of four causes. If you fail to get all the emulsion off, the joint will let go. Too little cement will cause trouble. So will lack of proper pressure while the cement is setting. Finally, if you work so slowly that the film cement is partly dry before the film ends are put together, the joint will be weak.

One of the illustrations shows two film joints. The right-hand one is perfect. The one at the left, made in the same splicer with a bit of delay in closing the joint, reveals a light area at one end. This indicates that the film is not cemented together in that area. Such a joint may get through the projector a few times without mishap, but is sure to let go when, in the end, one of the loose edges catches on something.

Film joints do not weaken with use. I have made endurance tests on joints equivalent to running through the projector once a week for twenty years, yet with no signs of weakening.

Two excellent ways are illustrated for holding short pieces of film while you are doing the rearranging and splicing. If you do any large amount of editing you will find that a number of scenes in short strips, when left on the bench, will soon get into a hopeless tangle. Aside from the time wasted trying to pick out the right one each time, some of the film is sure to get badly scratched.

One of the racks is merely a frame at the back of the table with a crossbar to which a number of wooden snap clothespins are attached. The other is a board with rows of key hooks. The separate scenes are coiled into little rolls, placed on the hooks, and labeled with paper tags if desired. The clothespin method is best and quickest for short scenes, but it is not so good for long strips.

An ideal arrangement would be a rack of clothespins for the short pieces, and a board, smaller and with fewer hooks than that shown, for holding the relatively fewer number of long strips.

CELLULOSE FILM KEEPS AIR FROM DEVELOPERS

TO PREVENT the deterioration of photographic solutions left in developing tanks or other open containers, a good method is to float on top of the liquid a sheet of transparent wrapping material of the cellulose film type. Cut out a piece slightly larger than the surface of the liquid so that the edges will fit tightly against the sides of the tank and form a good seal. No air can then reach the developing solution.—H. S.

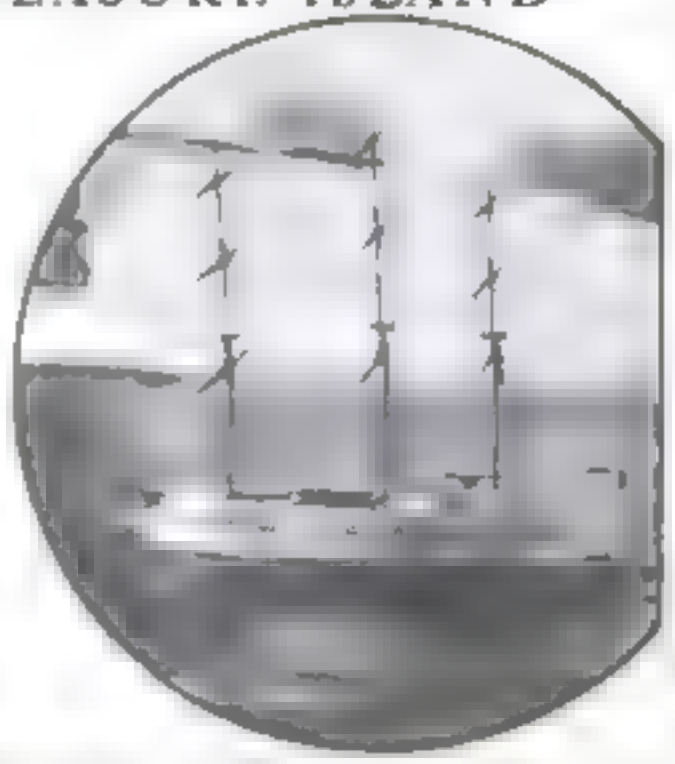
ATTACHING OBJECTS TO GLASS

WHEN any small object is to be photographed on glass in order that it will not throw a shadow, it is usually more convenient to place the glass in a vertical position. To attach the object to the glass, use a small piece of chewing gum.—O. B.

A Miniature Model Designed For Our Model-of-the-Month Club by Theodore Gommi

FICTION'S MOST FAMOUS SHIP

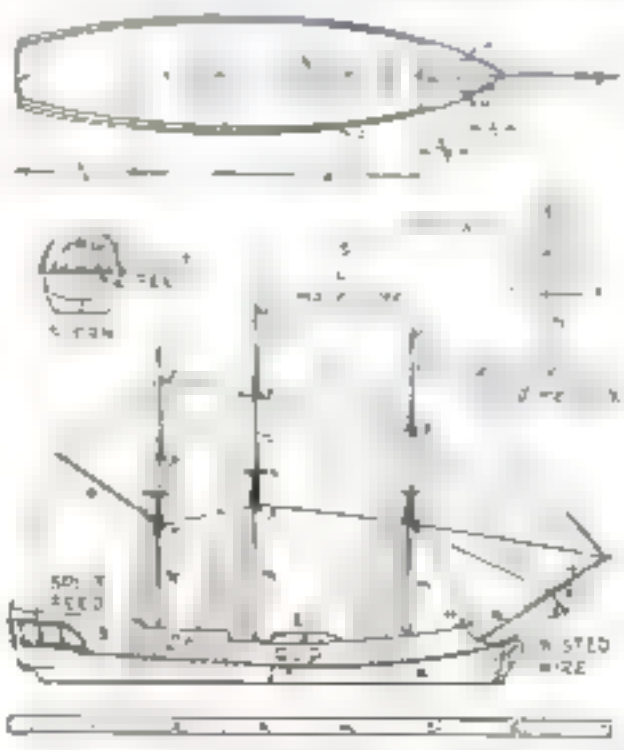
The *HISPANIOLA* OF "TREASURE ISLAND"



AT THE request of many readers, we are interrupting our series of historic American ships to include a water-line model of the *Hispaniola* as the seventh Popular Science Model-of-the-Month Club project. Those who have read Robert Louis Stevenson's immortal "Treasure Island" will need no urging to build this little shelf model of the ship described in that book. Aside from its associations with literature and adventure however the ship is one to appeal to any model maker.

For the plans from which this model was designed we are indebted to the Metro-Goldwyn-Mayer Picture Corporation, which built a full size *Hispaniola* for use in producing the current screen version of "Treasure Island." The plans were drawn by Jim Havens, a marine expert of that company.

Our model is built of easily obtained materials to the (Continued on page 84)

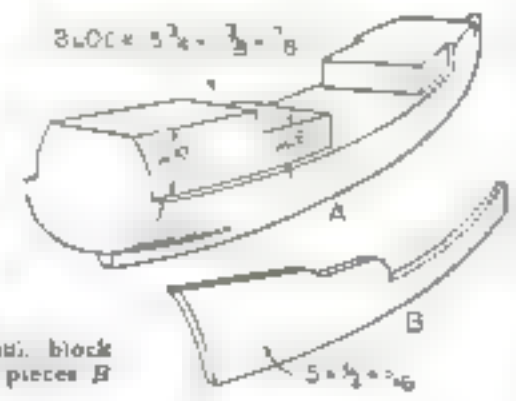


The assembled model and, at right, how the hull block is shaped and recessed to receive the bulwark pieces *B*

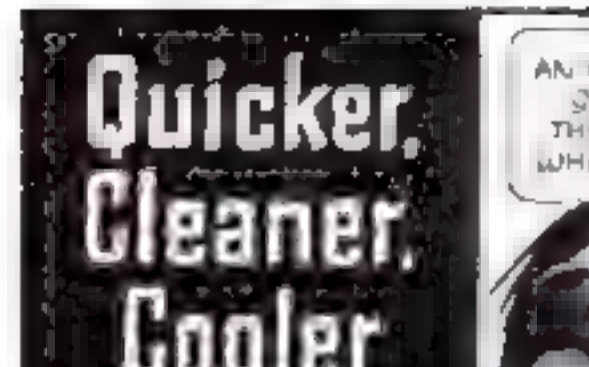
NOTES ON CONSTRUCTION

A B C D E N and *P* are balsa. *F G K* and *L* are ⅛ in. thick basswood. *I* and *J* are strips of split bamboo about 1/64 in. square. *Parts M, S* and *T* are round wood. *R* is stiff wire. *O* and *W* are pins. The cabin windows are split reed. The rigging is No. 100 black cotton. The dolphin striker is fine wire.

Painting. Hull, medium brown. Decks and inside of bulwarks, light buff. Fittings and spars, dark brown.



Two Whirling Thermometers Measure Humidity Accurately



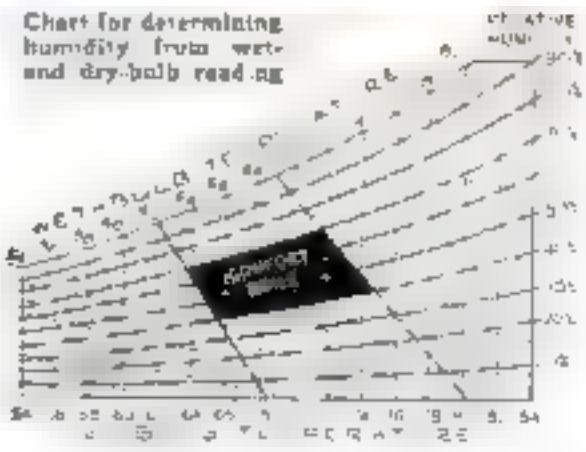
More weather articles coming! If you have written please be patient . . . and watch for the March issue.

HUMIDITY—the amount of water vapor in the air—is such an important factor in maintaining comfort and good health that more attention should be paid to its control. Here is an easily constructed instrument (sling psychrometer or hygrometer) that will indicate the percentage of relative humidity.

Obtain two similar thermometers and fasten them together, back to back, with wood screws. Under the bulb guard of one thermometer stuff a small wad of cotton. Drill a ⅛-in. hole through both thermometers at the top. Fashion a handle about 6 in. long and fasten this to the thermometers with a wood screw. Insert a washer between the handle and the thermometer and do not tighten the screw as it is a swiveling joint.

Moisten the wad of cotton with a few drops of water. Then whirl the assembly for half a minute and note the temperatures on both thermometers. The wet bulb should now read a lower temperature than the dry bulb, due to the fact that heat is required to evaporate the water. On the chart at the end of this article locate the dry bulb temperature at the bottom. For example, this might be 70 deg. Locate the wet-bulb temperature at the top, where it is indicated by the diagonal lines. Assume this as 61 deg. Now trace these two lines until they intersect. From this point follow the nearest curved dotted lines out to the right of the chart, where the percent of humidity may be read. In this case it is 60 per cent. This is within the comfort zone in the chart and indicates good humidity. The shaded area is the comfort zone for winter, and will tell whether the water pan on the furnace or other air-conditioning devices are operating with the desired efficiency. RALPH T. MOORE.

Chart for determining humidity from wet- and dry-bulb reading



Our BLUEPRINTS . . .

A *Gold Mine of* Home *Workshop* Ideas

BEFORE you start a new project in your home workshop make it a point to study our list of blueprints for suggestions. The following is a partial list. In general appearance it looks the same as the list published last month, but there are actually eighteen projects that have not appeared in any previous list, and new blueprints are being added from month to month.

Our blueprints are each 15 by 22 in. and cost 25 cents a sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by photographically illustrated instructions which supplement the drawings. If you do not wish this supplement, omit the letter "R" from your order and deduct 25 cents from the price given. Instructions alone are 25 cents each.

Many other blueprints are available. Send a stamped and addressed envelope for a complete list.

FURNITURE

Chests, Treasure, *78*	$.25
Coffee Table with Spiral Legs, *245A*	.25
End Table, American Empire Style, *243A*	.25
Floor Lamp with Tripod Base, *241A*	.25
Footstool, Upholstered, *246A*	.25
Magazine Rack Ladder Back Style, *250A*	.25
Mirror Frame with Split Turnings, *244A*	.25
Sewing Cabinets, Two, *31*	.25
Smoking Stand, Modern Design, *238A*	.25
[illegible] Stool, [illegible] high, *247A*	.25
Table, Four Leaf Clover, *239A*	.25
Tables, Tile-Top (wood and metal), *249A*	.25

SHIP AND COACH MODELS

{Construction kits are available for some of these models. See page [illegible]}

Aircraft Carrier—U.S.S. *Saratoga* (18-in.) and flush deck destroyer (6-in.), *215-62 R*	.75
Battleship—U.S.S. *Texas* (3-ft. hull), *197-198-199-200*	1.00
Bottle, Clipper Ship in, *121-122*	.50
Clipper Ship (30-in. hull), *51-52-53 R*	1.00
Clipper, Simplified (9-in. hull), [illegible]	.25
Constitution ([illegible]-in. hull), *57-58-59 R*	1.00
Cruiser *Brooklyn* (8-in.), *226*	.25
Cruiser *Tuscaloosa* [illegible], *234*	.25
Destroyer—U.S.S. *Preston* (3-ft. hull), *125-126-127 R*	1.00
Galleon *Revenge* (25-in.), *206-207-208-209*	1.00
Hartford, Farragut's Flagship (31-in. hull), special prints *221-222 R*	1.50
Mayflower ([illegible]-in. hull), *83-84-85 R*	1.00
Miniature Coach and Covered Wagon for Decorating Boxes, etc., *203 R*	.50
Motorboat, 29-in. Cruiser, *63-64 R*	.75
Motorboat, Working Model, 20-in., *144*	.25
Liner *Aquitania* [illegible], *175*	.25
Liner—*Manhattan* [illegible], *204*	.25
Liner—*St. Louis* [illegible]	.25
Privateer of 1812—*Swallow*, a Baltimore clipper (33-in. hull), *228-229-230*	.75
Santa Maria (18-in. hull), *74-75-76 R*	1.00
Stagecoach with horses, *144-145-146 R*	1.00
Steamboat, Mississippi (9-in.), *94-95-96 R*	1.00
Steamships *Savannah* (5 in. over all) and *Atlantic* (6 in.), *235*	.25
"Treasure Island" Ship *Hispaniola* (7-in.), *237*	.25
Viking Ship (20-in.), *61-62 R*	.75
Whaler *Wanderer* (20½ in.), *151 to 154*	1.00
Yacht *Rainbow* ([illegible]-in. hull), *231*	.25
Yacht *Sea Scout* (42-in. racing), *106-107 R*	.75
Yacht (20-in. racing), *48 R*	.50

RADIO SETS

All-Wave Portable (battery), *217 R*	.50
Amateur Short Wave Receiver, *155*	.25
Amateur Radio Transmitter, *183-184*	.50
Amplifier, Three Stage Audio-Frequency, *43*	.25
Five Tube Short Wave (A.C. or D.C.), *223*	.25
Full Electric Headphone Set, *130*	.25
One Tube (battery operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25

MISCELLANEOUS

Acrobatic Monkeys Toy, One Legged Table and Hat and Coat Rack, *248A*	.25
Bird House, Log Cabin, *244A*	.25
Doll's House, Colonial, *72*	.25
Doll's House, Furniture, *73*	.25
Tie Rack, Extension Book Rack and Turned Box, *242A*	.25
Toy Airplane Cockpit with Controls, *114*	.25
Toy Birds and Animals, Jig Sawed, *38*	.25
Toy Drill Press, Lathe, Saw, etc., *113*	.25
Toy Dump Truck, Fire Engine, etc., *101*	.25

BOATS

*Canoe, 16-ft. Canvas Covered Kayak, with sail, etc., [illegible] *183-184 R*	1.00
*Duck Boat, Folding, *170 R*	.50
*Outboard Racer, 10 ft. [illegible] 14 [illegible], *211-212 R*	.75
Sailboat, Motorboat Combination (15 ft. catboat) [illegible] R	1.00
Marconi Rig with Jib for Above, *133A*	.25
*15 ft. Runabout or Sportboat (outboard or inboard motor), *175-176-177 R*	1.00
*13-ft. Utility Rowboat (can be sailed or used with outboard motor), *224 R*	.50

NOTE: Full-size patterns for any boat marked with an asterisk (*) will be drawn to order for $1.50 extra. Simply add this amount to the cost of the blueprints. About one week is required to fill orders for patterns.

Popular Science Monthly
381 Fourth Avenue, New York

Send me the blueprint or blueprints, numbered as follows:

I am inclosing .... dollars .... cents

Name ____________

Street ____________

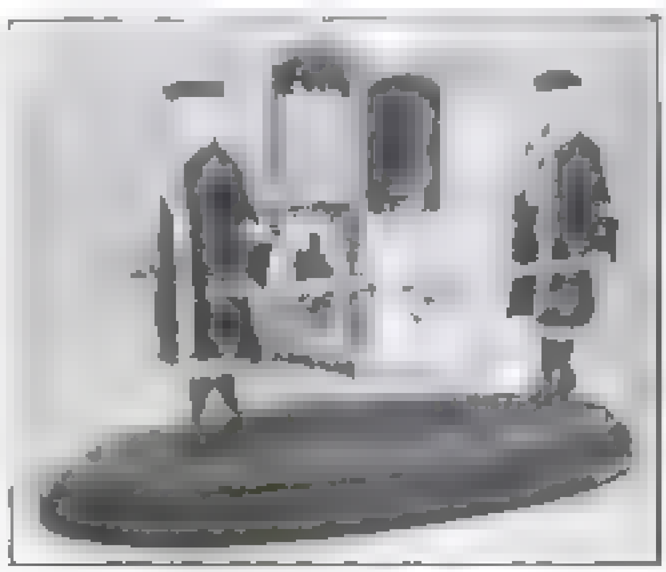
City and State ____________

Please print your name and address clearly.

MODEL OF A

Queen's Sedan Chair

ARE you one of the millions of movie goers who have been attracted by the gorgeous costumes and settings of the many recent historical pictures? If so, you can reconstruct for yourself on a miniature scale one of the most picturesque conveyances of olden times—a sedan chair used by Marie Leszczynska, wife of Louis XV of France. Our Blueprints Nos. 123 and 124 (price 50 cents) contain plans for a [illegible] in. scale model standing about 7½ in. high.



HOW TO RESTORE ALARM CLOCKS TO SERVICE

CLEANING a clock is frequently the only repair required to restore it to service. It is a simple process, as you may find out for yourself by practicing on your alarm clock the next time it stops.

If, for example, you have one of the popular large alarm clocks, first loosen the three small screws at the back near the rim, and twist the movement in a clockwise direction until the screws slip through the enlarged portion of the slots. Next, remove the two winding keys and the four slotted nuts on the back, and slip the movement from this part of the case. Slip a pair of diagonal cutting pliers under the minute hand and pry it off. Then remove the other two hands in the same way.

The dial is removed by straightening the ends of the four lugs that pass through holes in the frame of the movement. Now pull out the small brass wedge that holds the end of the hairspring on the balance wheel, and turn the wheel until the end of the spring slips out of the slot, and also out of the slot in the regulator lever. Loosen one screw at either end of the balance-wheel staff until it can be removed.

Dissolve some mild white soap chips in water, add ammonia, and suspend the movement in the solution from a wire for about five minutes. Then rinse it thoroughly in gasoline. Brushing with a small pointed stick will remove any remaining dirt. The balance wheel should be cleaned in the same manner but be very careful not to bend the hair spring. It is a good idea to dry off the gasoline with a fan, or by placing the movement in the sunshine.

If the points of the balance wheel pivots are dull or rounded off, they should be sharpened. The shaft can be placed in a chuck if a small lathe is available, and the pivots ground to a fine point with an oilstone. An alternative method is to place the balance staff in a pin vise and rotate it with one hand while grinding with the stone in the other hand. A small slot can be filed at the edge of a bench, and the end of the shaft rotated in the slot, with enough of the point protruding to grind. It is also well to clean out the depressions in the two screws in which these pivots rotate.

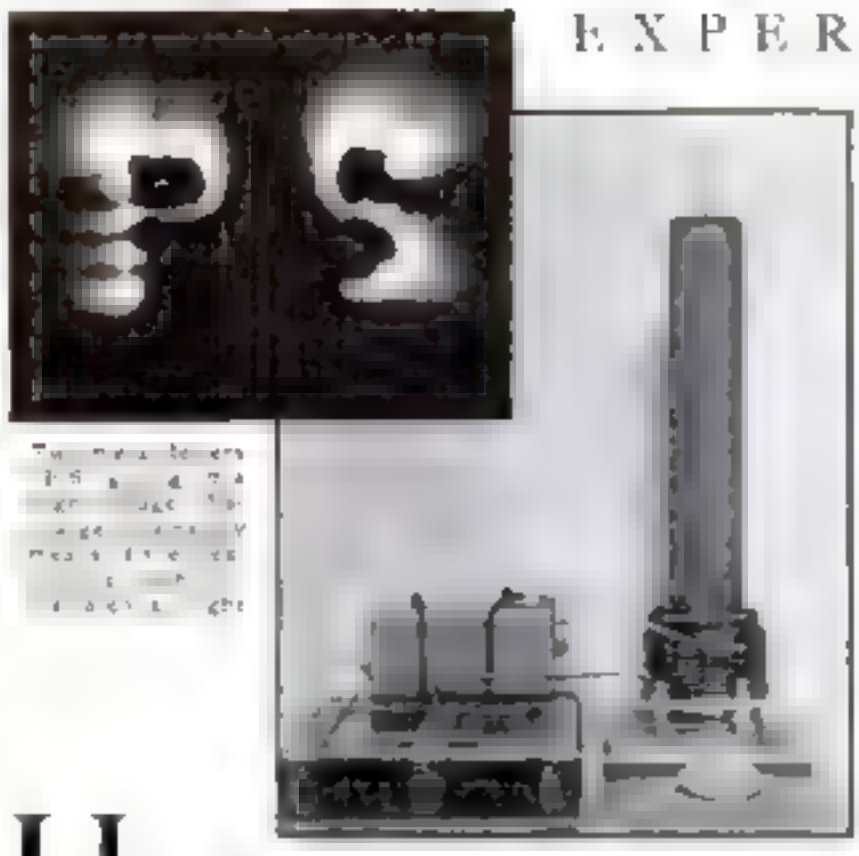
TO REASSEMBLE the parts, first replace the balance wheel, making sure that the pin on the wheel slips into the slot in the lever. Then thread the end of the hairspring through the slot in the regulator lever and through the slot where it is clamped with the small brass wedge. Before clamping the end of the spring, hold the wheel so that the pin and the slot are in a straight line with the balance-wheel shaft and the lever shaft. Allow the spring to move freely, and then clamp at this position. If the clock does not tick evenly, the end of this spring should be moved a very little in either direction until it does.

A few drops of light machine oil should be placed on the mainspring and on the alarm spring, and a small drop of very light oil, preferably clock oil, on each bearing. Also put a drop on the balance-wheel pin, and a drop on each arm of the escapement. Use a piece of wire, about No. 22, for applying the oil to the bearings. Now the other parts may be assembled in the reverse order from which they were taken apart.

In order to get the alarm set at the correct position, put on the alarm-set hand first. Then turn the minute-hand set knob on the back in the backward direction until the alarm-set hand begins to turn backward. Turn until it is at some convenient position, such as three o'clock, then put on the hour and minute hands at the three-o'clock position. The clock now can be placed in the case and will be ready for use.—BUD FISHER.

SPECTACULAR

High Frequency EXPERIMENTS



Made with Aid of Junked Ignition Coil

By KENDALL FORD

HERE is a high-frequency outfit capable of giving a good 3-in. spark and providing an endless number of weird and interesting experiments, yet it can be built in a few hours time and almost entirely from salvaged materials.

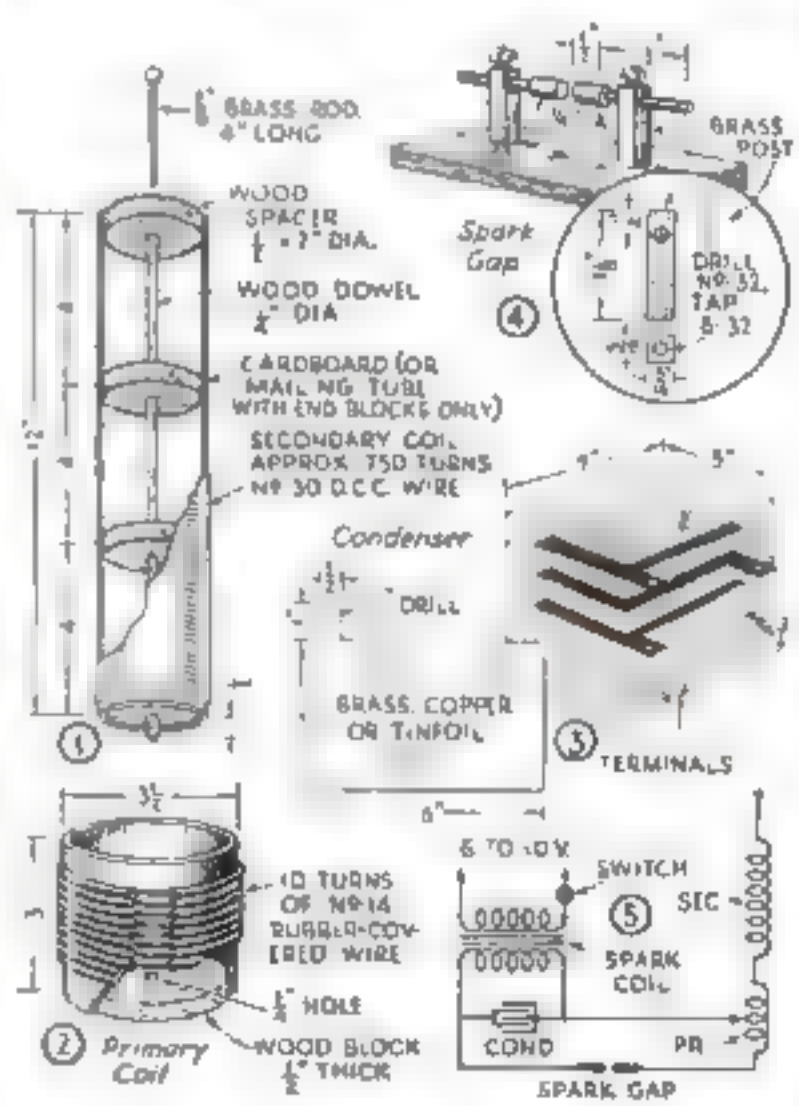
Obtain a mailing tube approximately 2 in. in diameter and 12 in. long. Cut two circular blocks of ½ in. wood to fit into the ends of the tube, and bore a ¼-in. hole through the center of one of the blocks. Glue a short piece of ¼-in. round wooden rod in the center of the latter block and allow it to extend ½ in. from the surface as a dowel. Glue one block in each end of the tube, shellac the tube, and allow it to dry

If a mailing tube is not available, a satisfactory substitute may be made by making a form as shown at Fig 1, wrapping it with several layers of thin cardboard, and securing the end with glue. No nails or screws should be used in the construction of the high-frequency coil.

Wind the cardboard tube to within ½ in. of each end with No. 30 double cotton-covered wire which will require approximately 350 ft or a fraction over ½ lb. Insert a ½-in. brass rod, 4 in. long, in the top end of the coil form, and solder one end of the coil to it Fasten a small metal ball to the upper end of the rod.

For the primary coil, obtain a cardboard tube 3 in. long and from 3 to 4 in. in diameter A section of a salt or oatmeal box makes a good form. Cut a circular block of wood to fit into one end, drill a ½-in. hole through the center, and glue in place. Wind the form with ten turns of No. 14 rubber-covered wire from which the insulation has been removed for a space of ½ in on each turn, as shown in Fig. 2. The wire is first wound on the form, the spaces to be bared are marked with a sharp knife, the wire is removed, and the insulation cut away. Secure the wire by removing the insulation from the end and passing the wire through a small hole in the cardboard form. Insert the extended end of the first-made or secondary coil into the same hole in the bottom of the primary coil, and glue in place. Then solder the lower end of the secondary coil to the lower end of the primary coil.

For the condenser obtain fourteen pieces of glass, 5 by 7 in. Old photograph plates from which the emulsion has been removed



How the primary and secondary are wound on cardboard tubes; the condenser and spark gap, and the wiring diagram

are excellent, but any scrap pieces of glass will do. Cut thirteen pieces of brass, copper, or tinfoil to the size and shape shown in Fig. 3. Drill holes in the tabs at the end of the sheet for connecting screws as shown. In stacking the condenser, place a sheet of glass on a flat surface, then a sheet of foil on the glass, another sheet of glass, then a sheet of foil with the tab at the opposite end. Continue until the condenser is assembled as in Fig. 3. The foil should be placed on the glass so that there is a margin of ½ in. all the way around. Bind the condenser together with friction tape.

The details of the spark gap are shown in Fig. 4. Two brass posts are mounted on a block of well-seasoned wood, and the adjustable electrodes made from pieces of ¼-in. round brass rod soldered to ½-in. pieces. The latter are held by means of No. 6-32 set screws.

A vibrator type Ford ignition coil will be required to excite the high-frequency coil. One may be obtained from any auto wrecking yard, but make certain that the condenser within the coil is not damaged. If the coil gives a hot spark at least ½ in. long, it will be satisfactory.

The diagram of connections is shown in Fig. 5. The wire from the spark coil to the primary of the high-frequency coil should be flexible and should terminate in a spring clip to enable its being connected at any turn of the primary coil. The spark gap should be separated not more than 1/16 in. Connect the primary to a transformer or battery of from 6 to 10 volts, and vary the number of primary turns in the circuit until the longest spark is obtained from the discharge ball at the top of the coil. If the coil is operated in semidarkness, the effects are most spectacular, due to the fine corona discharge that surrounds the upper coil but is not visible in a strong light.

A Low-Cost Outfit

EXPENSE need no longer stop you from building your own high-frequency apparatus. Mr. Ford, who is a master at making fine electrical equipment from odds and ends, has designed this outfit so that it can be made at trifling cost. His plans are offered in response to the great interest shown by readers in our recent article on a much larger Tesla coil (P. S. M., Dec. '34, p. 65), which required a high voltage transformer.

RUBBER-STAMP PRINTING

A good imitation of printing can be obtained with a rubber stamp such as is used for impressing names on envelopes. Regular printing ink must be used. It is rolled out on a sheet of glass, which is used as a stamp pad. Only a thin film of ink is necessary. To prevent the rubber of the stamp from rotting because of the oily ink, soak it for several hours in a hot gelatine solution. Then wipe off the surplus and coat with a saturated solution of ammonium or potassium bichromate, and allow this to dry in sunlight for a day before using.—K. L. Rosauer.

NONSLIP COAT HOOKS

When coat hooks sometimes allow clothing hung on them to slide off and fall to the floor. A good remedy is to slip over each hook a short length of small rubber tubing, preferably of the ribbed type, so that it will form a tight fit.—E. A. B.

Handmade metal fittings set off this fine piece of oak furniture—
Has lining of tarnishproof cloth

By Herman Hjorth

A Chest *for the Family Silverware*

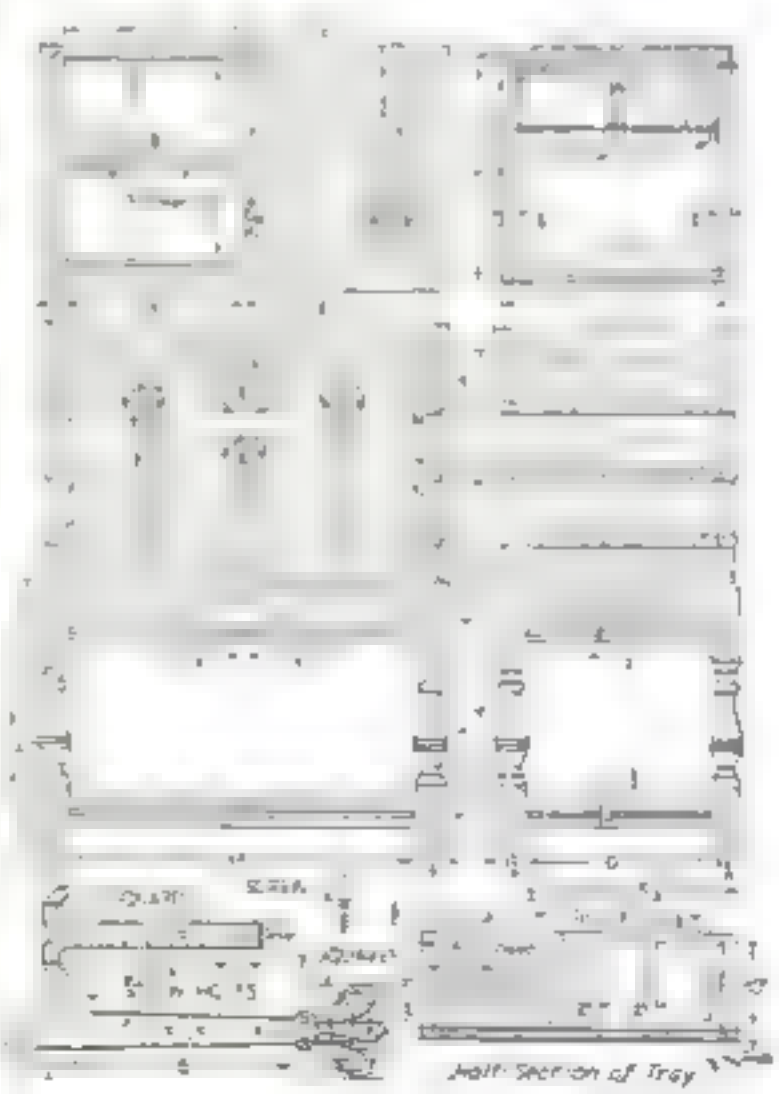
CHESTS are among the oldest and most romantic types of furniture. The one illustrated is of medieval, iron-bound design and is intended for holding the family silver. The knives, forks, and spoons are kept in a tray supported on cleats, while bowls, pitchers, and other vessels are stored in the bottom of the chest. Instead of a tray, a box made especially for flat silver and lined with tarnishproof cloth may be bought at a department store or from dealers in silverware. Tarnishproof cloth, which may be obtained by the yard, should also be used for covering the chest sides, bottom, and underside of lid.

The actual construction is very simple. A good grade of white oak is recommended. The front, back, ends, and bottom should preferably be glued up of two boards. These parts are then planed and squared to dimensions. The ends are joined to the front and back with a dado-and-rabbet joint as shown in the plan view. This joint may be made either by hand or machine, but in either case it is advisable to cut the dadoes first and then plane the rabbets to fit these. The bottom is joined to the sides and ends with a groove-and-rabbet joint, which is made in the same way. It is inserted at the same time the front, back, and ends are glued, but no glue should be applied to the bottom or the grooves into which it fits, in order that the bottom may shrink or expand a little.

The lid should be glued up of at least three boards so that it will not warp. It is fastened to the back of the chest with three hinges 1½ in. wide and 1 in. long. A frame of ¾ by 1 in. strips is made to fit into the top of the chest. It is screwed to the underside of the lid so that this closes very tightly.

The decorative metal fittings may be 16-gauge brass, copper, iron, or monel metal. Cut the pieces oversize and hammer-mark them with a ball-pein hammer. A cardboard pattern is then laid on the metal and its outline marked with a scratch awl or other sharp steel point. The holes for the screws are drilled, after which the outline is sawed with a jeweler's saw and smoothed and rounded with a file. Bend these parts at right angles to fit around lid and sides as shown in the sectional view, and drill 3-16-in. holes for the screws, which

(Continued on page 89)



The stand, made separately, has a rabbet in which the chest rests. The flatware tray can be divided in any way desired

CHEST FOR SILVERWARE

(Continued from page 88)

may be obtained with square heads, either machine made or hand forged. The fittings should not be applied, however, until the chest has been stained and finished.

If the tray is to be made, it should preferably be dovetailed at the corners. The plywood bottom is fastened with glue and screws. The partitions and racks should be spaced to suit individual requirements and preference.

The chest is placed on a stand made of four turned legs, four rails, and four stretchers. It fits into a rabbet cut in the edge of the rails and the ends of the legs. These rabbets should be cut before the stand is glued together. Note that the rails are set flush with the legs, but that the stretchers join them in the center of the square part. The joints may be either mortise-and-tenon or dowel joints. A bead is made on the rails and stretchers with a scratch stock, as explained in previous articles, before they are glued to the legs.

The chest may be given a weathered oak or a brown oak stain. If the latter is used, a striking effect may be produced by filling the pores with white (natural colored) filler. The filler is thinned with benzine or turpentine until of the consistency of cream, painted on liberally, and worked thoroughly into the pores with a brush. It is allowed to dry until it turns flat and the surplus is then rubbed off across the grain with a piece of burlap. After being wiped clean with a soft cloth, the filler is left to dry for twenty-four hours. Then one or two coats of very thin shellac are applied. Rub the shellac smooth with No. 2/0 steel wool and finish with a coat of liquid wax. Let the wax dry several hours before rubbing to a polish with a clean, soft [illegible]

List of Materials

No. of Pieces	Description	T.	W.	L.
4	Legs	[illegible]	[illegible]	14
2	Rails	[illegible]		[illegible]
			3	[illegible]
2	Stretchers			[illegible]
				[illegible]
2	Front and back	[illegible]	[illegible]	
2	Ends	[illegible]	[illegible]	[illegible]
1	Bottom	[illegible]	[illegible]	[illegible]
1	Top	[illegible]	13 [illegible]	[illegible]
1	Frame			[illegible]
2	Tray sides			[illegible]
2	[illegible]			[illegible]
1	[illegible]	[illegible]		
	[illegible] plywood	[illegible]		[illegible]
1	[illegible]		[illegible]	[illegible]
1	Metal straps		[illegible]	12
1	" strap		[illegible]	[illegible]
6	[illegible]			15
1	[illegible]			
1	[illegible]			[illegible]
	[illegible] type)			

Note: [illegible] are given in inches and are finished sizes.

MODEL OF *HISPANIOLA*

(Continued from page 82)

scale of approximately 1 in. equals 25 ft. Either pine or bass wood can be used for the hull, although the latter is easier to carve.

A construction kit with all the necessary balsa wood, fiber, split bamboo, wire, paint, and other materials, and a full-size blueprint and detailed instructions may be obtained for 50 cents (see page 102). These kits have been specially designed for the Model-of-the-Month Club, but other readers can obtain them, while the supply lasts, for the same price.

The full-size blueprint, detailed instructions, and itemized list of materials are also available separately for 25 cents. Order Blueprint No. 257.

Members of the Model-of-the-Month Club are entitled to receive a copy of the instructions free, provided they send a self-addressed, stamped envelope.

OLD TOY REBUILT INTO STREAMLINED TRAIN

(Continued from page 63)

tween roof and floor (inside) is 1¼ in. Use narrow spacing blocks (⅛ or 3/16 in. wide) at the pivot end of each car. Place these far enough from the ends so they will not be in the way of the shields and so they come between two windows. Build up the back of the rear car and front of the locomotive with blocks from which the tail and nose may be shaped. Glue these parts together.

Jig-saw the plan and elevation of the nose and tail to remove most of the excess wood, then shape to the proper contour with a sander or file. Also, since the cars are narrower at the top, sand the edges of the roof and floor sections slightly to get the proper streamline taper. Nail small wooden strips, 3/16 in. square, along all top and bottom edges on the inside of each car, set 1/32-in. in, to serve as supports for the window material which goes back of the sidepieces.

THE best way to mount lights in the cars is to drill holes up from the bottom large enough to push the lights up into them. The sockets for these lights are carried on a thin strip of brass mounted along the center bottom line. Connect this strip to the hinge plate of the car and wire the center screws of the sockets to the third-rail shoe. Use 6-volt tubular radio lamps in series with a 100-ohm resistance so the lights can be used with from 12 to 15 volt power. Higher voltage lamps can be used if desired, but these are larger in diameter.

The detail of constructing the front end of the locomotive can be seen in the illustrations. A strip of brass ⅛ by 1/32 in. is run all the way around the front, and a ⅛ by ¼ by 1/32 in. angle is framed under the roof of the cab to hold the nose to the rest of the car and give support against collisions. Cut away all excess wood back of the nose (the exact shape is not important) to form an opening for the motor. The bumper bar is made of 1/16-in. square brass and is soldered against the ⅛ by 1/32 in. brass strip that circles the front.

The radiator grating is made of 1/32-in. brass wire, cut to length, U-shaped, and driven in like staples. The cross members and frame are soldered on. The cab windows are recessed to leave the frame of the windows in relief. The cab roof is an extra piece of wood ½ in. thick, shaped to the proper lines. It is attached to the body by two machine screws (6-32 flathead) tapped into the brass strip that supports the motor.

The headlight is made from a ⅝-in. square piece of brass 1⅛ in. long. This is drilled out to receive the light and socket and is rounded off at the top. A hole is drilled in the top, near the front, to receive a ⅛ in. telephone lamp cap with a clear lens. This takes care of the vertical shaft of light. The headlight is then mortised into the cab roof and attached with a 2-56 flathead screw from the underside of the cab roof. This screw also carries a spring which grounds the light to the motor-supporting strip. The center screw of the socket is wired to the motor's third-rail shoe.

THE ventilators on the cab roof are cut from ⅛ in. outside diameter brass tubing and inserted in holes drilled to fit. They are ⅝ in. long and cut off on an angle on top, the slope being ⅛ in.

A few final details can be added, if desired. Each car should really have at least four ventilators, two at each end. They are semicylindrical in shape ½ in. long, ¼ in. wide, and about ⅛ in. high. The tail of the train and the nose each carries two classification lights. These parts may be molded of plastic wood. (Continued on page 91)

OLD TOY REBUILT INTO STREAMLINED TRAIN

(Continued from page 90)

composition. The actual lights can be represented by glass beads. Also add a brass wire handrail at each door. This can be made from 1/32-in. diameter wire.

Assemble all the cars and try the parts to be sure they work properly. Then disassemble and paint. This is best done by spraying on two coats of high-grade lacquer. Use a rich tan for the roof and floor sections, also the truck and motor skirts and the top and bottom of the shields. Paint the inside a glossy white. The grille on the nose, including a strip ½ in. wide all around it, is painted a canary yellow. Be sure to fill all cracks with composition wood before painting.

If any furniture is to be placed inside the cars, it should be made and inserted before the sides are put on. A floor plan with all internal details may be obtained at the ticket offices of the railroad.

THE sides of the car are made of heavy pressboard, although lightweight brass could be used, if desired. They are 1½ in. wide and shaped at the nose and tail to fit the body lines. The heavy lines on the assembly drawings give their outlines. Lay out all windows as indicated on the drawings and photographs. Note particularly that the drawings show the left-hand side of the train, looking toward the locomotive. The right-hand side is slightly different in respect to the windows of the first car, and the third car has no rear door on that side, as can be seen in the photograph that stretches across the second and third pages of this article. When the sides have been laid out, cut them accurately with a razor blade or chisel.

It is necessary, in addition, to cut out pieces of black 4-ply Bristol board as long as the sides and 1 3/16 in. wide, and lay out the windows as on the sides, but 1/32 in. smaller all around. These serve as window frames. Cut pieces of transparent cellulose wrapping the same size as the window-frame strips to represent glass. Paint or spray the sidepieces with two coats of canary yellow lacquer.

In mounting, place the cellulose film between each side and window-frame piece so the frames are properly aligned. Glue and nail in place. Reinforce the sides at all ends with lightweight shim brass, U-shaped, and crimped in place. Brass beading 1/64 in. thick by 1/16 in. wide is run around the top and bottom edges of the car. Drill this strip every half inch with a No. 60 drill before attaching it with small escutcheon pins. Paint this strip red before applying so it forms a stripe between sides, roof, and floor.

The cars are now lettered in a rich tan or brown, preferably of the kind called "Japan colors." The name UNION PACIFIC appears above the windows on each car. These letters are ⅝ in. high and slightly wider than ¼ in. The front car carries the number M-10000 on both sides and the wording UNITED STATES MAIL RAILWAY POST OFFICE in two lines on the left side only. The middle car is labeled COACH and the rear car COACH BUFFET. Paint a narrow brown line around each door.

The lettering is most important. If poorly done, it will spoil the effect of an otherwise thoroughly workmanlike model. The task can be somewhat simplified by borrowing type of about the right size from a print shop. The type is inked by means of an ordinary stamp pad and then used to mark the letters on the train. After the ink has dried, the letters can be carefully painted over.

Now check over all the details. Give the motor and trucks some oil, and let her run. You will have a model to be proud of, and one that all your friends will admire.

UNIQUE CAMERA CASE

(Continued from page 65)

counting from the first. In every other row, the outside working cord is double-looped over the outline cord to hold it in place and to give an even edge to the strip. This is shown at the left in Fig. 2

After the thirty-five rows have been made, extra cord for the sides of the case must be added. Four doubled strands of brown cord, each 10 ft. long, are looped over the outline cord at each side. Continue by knotting the widened strip for thirty-five more rows, after which you can return the outline cord to the middle blue strip. Knot enough of the latter, about eight rows, to form the bottom of the case. This can be measured, over the camera, as shown in Fig. 3

You can now return the outline cord to the outside, knotting in the brown cords until the case is finished. After knotting nine rows, drop a knot on each side, in the center, in making each row. This will form an inverted "V." To the two middle strands, knot the middle of a 3 ft. length of brown cord, as in Fig. 4. With the latter, make simple hitches around each of the working strands (Fig. 5). This forms a part of the design for the front of the case. Continue with square knots in the center and at the sides of the design, forming the rough shape of a heart outlined in brown. The ends of the brown cord are knotted together at the back of the case, and made secure with household (cellulose type) cement, as shown in Fig. 6. Continue with square knots until the strip is finished.

The case is sewed together with the regular knotting cord threaded through a large needle

In ending the strip, bring the outline cords to the middle, and over them make hitches with the working cords. The final knots are then lightly cemented and the cord ends severed with a razor blade

A length of the blue cord, threaded in a large darning needle, is used to draw together the sides of the case. You can then take it to the glove counter of any clothing store and have a snap fastener applied at a cost of about ten cents. When the flap is fastened down, it should come at the top part of the brown heart design

The shoulder strap is made with two lengths of brown cord, one 32 ft. long and the other 9 ft. Both are run through one side of the case at the top. Use the shorter strands as filler cords, and over them make regular square knots with the long cords. The making of such a strap, which is very simple, has been previously described (P. S. M., July '34, p. 76). After it is knotted to the desired length, which is about 4 ft., it is tied into the other side of the case

WAXING SQUARE-KNOT CORD

To give knotted cord articles a high polish, first run the cord through a cloth pad which has been treated with paste furniture wax. After the article has been knotted, rub the surface with a cloth.—K. M.

PLANT PARTNERSHIPS FOUND WITH MICROSCOPE

(Continued from page 39)

green chlorophyll that you have encountered in the cells of other plants, for the fungi are entirely devoid of this important plant substance, and for this reason they are doomed to perpetual stealing of their food in ready made form.

The gills are perhaps the most interesting part of any mushroom or related fungus. It is the gills that produce the all-important spores, which travel on the winds and in the bodies of animals to other places favorable for the starting of new colonies. Such places are not numerous, considering the earth's land area, so that each mushroom or other fruiting body must produce millions or even billions of them. It is to provide a great area in a compact space that the gill formation has been developed by the mushroom.

THE spores may be produced in a variety of ways. Among the most common is the system of club-shaped basidia that cover the surfaces of the gill plates, like masses of tenpins standing with their sides touching. The basidia of the common mushroom usually produce two to four nearly spherical spores each, the spores growing from little tips that project from the tops of the club-shaped structures. The spores ripen, fall off, and are caught by the wind and carried away. Another common method of producing spores makes use of long, tubular pods, or asci, in which the spores grow like rows of beans or peas. When the spores are ripe, the pods burst and liberate them. These different methods of spore production have given rise to the names Basidiomycetes and Ascomycetes respectively. Several other methods of bearing spores are known.

With your microscope, you can see the spore-bearing basidia or other organs. Remove some gill plates from a mushroom, and tear them into small pieces in a drop of water on a slide. Lay a cover glass over the drop, and examine carefully at 200 diameters or so. Here and there you will find a piece of gill tissue that is arranged so that you can see the rows of basidia massed compactly on its surface. If the specimen has reached the spore-releasing stage, you can observe the countless numbers of spores that have been given off. To collect the spores alone, lay the cap from a mushroom on a piece of glass or paper, and place under a bell jar. The spores will collect on the support in a pattern determined by the arrangement of gills.

A LICHEN generally is a union of an alga and a member of the Ascomycetes. Sometimes, when examining a lichen under the microscope, you can see the tiny spore-pods or asci. Incidentally, only the fungus part of the lichen seems to have the power of reproduction.

Although the fungus spore serves the same purpose as the seeds of higher plants, it differs greatly from them. A seed contains a tiny embryo plant, while a spore is simply a cell that possesses the power to grow into a plant. When a mushroom spore, for instance, alights on a moist layer of rich soil where growing conditions are right, it develops into a tiny speck of mycelium. This grows and penetrates the surrounding soil. Its job is to absorb food from the soil, to expand and to produce the fruiting bodies or mushrooms. When mushrooms are grown commercially the beds become interwoven with the mycelium threads. The bed material is compressed into bricks and sent to other growers who, by planting bits of the brick, can start new beds.

Your fascinating examination of fungi need not end with an investigation of the common mushroom. There are hundreds of other kinds of fungi or molds, (Continued on page 94)

PLANT PARTNERSHIPS FOUND WITH MICROSCOPE

(Continued from page 93)

which you can find almost anywhere. A photographer one experienced considerable trouble because a tank in which he rinsed films and plates became filled with masses of threadlike material. Examination showed that the material was a fungus plant, thriving on the gelatin that dissolved out of the film and plate coatings. This fungus proved to be a beautiful object under the microscope.

Fungi studies can be carried on at any time of the year. In winter mushrooms can be purchased from stores. A trip into the woods will provide bits of decayed wood that will produce abundant crops of fungi when placed in a warm, moist place and lichens that can be stirred to life by similar treatment.

THE problem of making temporary slides of fairly thick sections can be solved by a method developed in one of the government microscope laboratories. This method consists of spinning a paraffin ring on a glass slide, to make a shallow cell. Paraffin can be used when the mounting medium is water or some substance that does not dissolve it.

Materials required include a spinning wheel whose construction already has been described in this series, and a slender wax candle. You will have to make such candles yourself for it is difficult to purchase them.

To make a candle, obtain a piece of brass pipe about one fourth inch inside diameter and six inches long. Plug one end with a piece of wood or a cork. In the center of this cork, on the end that is in the pipe, fasten loosely a pin or small nail, and tie to it one end of the heavy cord that is to serve as a wick. The nail or pin must be so loose that it will pull out of the cork when the latter is removed. With the wick running up through the tube, fasten the latter in an upright position, with the corked end downward, and pour melted paraffin into it. When the paraffin is on the point of becoming solid, adjust the wick so that it will be centered.

WHEN the wax has cooled, remove the cork from the lower end, and hold the wick in one hand so that the mold dangles below. With a gas or blowtorch flame, gently warm the mold evenly over its surface, until it drops off under its own weight. When carefully done, only a thin layer of wax will be lost. Straighten the candle while it is still pliable, and lay on a flat surface to cool.

To spin a paraffin ring, place a slide on the wheel of the spinning machine, light the candle, let it burn for ten or fifteen seconds, blow out the flame and immediately touch the wick to the slide, which has been set spinning. The molten wax of the wick will flow out on the glass and cool instantly, forming a ring that can be built up to any practical thickness. Cells thus formed have remained intact for years.

The inexperienced microscopist frequently has difficulty with air bubbles. He discovers what he thinks to be a new kind of cell or animal, only to learn in the end that it is a tiny air bubble that is drifting across the field of view. Sometimes these bubbles, acting as tiny lenses, produce beautiful effects. One of the first things instructors of classes in microscopy teach their students is to recognize an air bubble. It is a good idea for every beginner in microscopy to follow this rule, and study bubbles before turning his magic lenses on anything else. Production of air bubbles is easy, frequently exasperatingly easy. Simply drop a cover glass carelessly on a drop of water placed on a slide, and you generally will imprison at least one bubble. Water from a half-filled flask that has been shaken vigorously may provide an abundance of tiny bubbles, when a drop of it is placed immediately on a slide and cover glass added.

SHOP LIGHTING TEST

(Continued from page 71)

by various manufacturers. You may hesitate at the first cost of installing them, but they will last for years.

"Why not use a single 300-watt lamp over the bench, and save the cost of one reflector and socket?" you may ask. The reason for using two lamps of equal size is that they give nearly shadowless lighting, which is best for most bench work, whereas a single bulb throws confusing shadows.

WHEN the lamps are placed higher than 2½ ft. above the bench, they can be suspended directly over the front edge. Also, if much work is to be done in a vise that projects out from the bench, the lamp should be placed a little farther forward than the 6-in. position.

For lathes and similar machines, a single 150-watt lamp unit suspended a little to the right of the faceplate end of the headstock spindle, generally is satisfactory. It is convenient, you will find, to mount a lathe lamp on a swinging arm, and provide some means of adjusting the height as well as the lateral position.

Smith suggested a way in which a single lighting unit employing an R.L.M. dome can be made to do the work of several. Obtain a key socket, preferably one made of porcelain, that is threaded for a standard fixture ring. With the ring screwed securely in the socket, the unit can be suspended from a small hook, and the hooks can be distributed over the shop so that the light can be moved where it will do the most good. Of course, you will have to provide sufficient wire to permit shifting. Use rubber-covered cord and a rubber-jacketed plug. A lamp of this type is better, in most cases, than the more familiar but generally less efficient extension unit.

It is convenient to have a localized source of light on drill presses, band saws, jig saws, and almost every other shop machine. Then there is no trouble in directing light where it will do the most good. A 25- to 40-watt bulb is large enough for machine lights. It must be shielded by a reflector that will direct the light on the work, yet will not be too bulky.

The unit illustrated in use on a milling machine has a reflector of the approved type. Made of metal, with baked-on enamel finish, it fits snugly about the bulb and has no useless bulk. The shade shown is priced at 90 cents, and the chromium-plated socket, cord, and plug cost 35 cents additional. The unit is fastened by a ball-and-socket arrangement that formerly was part of a 25-cent clamp for portable fixtures such as those sometimes employed by photographers. However, you can make a simple bracket by bending a narrow strip of metal around the socket, clamping it with a small bolt running through holes, and drilling the protruding 2- or 3-in. portion so that it can be fastened by a bolt already on the machine, or one put there for that purpose.

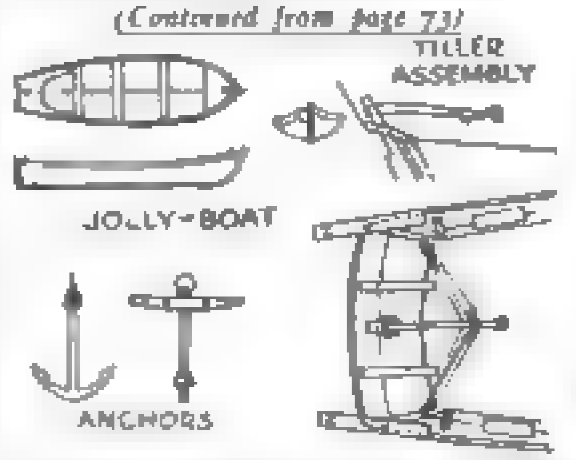
Another convenient lighting gadget for the shop is a small bulb attached to the end of a flexible lamp cord so that it can be let into holes and restricted places where light from ordinary sources cannot be directed. A 6-volt radio dial lamp, energized by a doorbell transformer, will serve nicely.

Another still more portable unit consists of a flash-light bulb on the end of a pair of flexible wires, connected to a standard battery case. For similar purposes a useful lamp is the 3- or 6-watt S-6 Mazda, which operates on 110 volts. It is somewhat larger than the other two lamps mentioned.

Finally, the illumination can be improved by painting the interior a light color. It will show dirt more quickly, but that will serve as an indicator to warn you when a housecleaning is in order.

RIGGING THE *SWALLOW*

(*Continued from page 73*)



The 3-in. long jolly boat, the 1-in. long anchors, and method of rigging the tiller

with single blocks, the whip of which fastens to the eye in the end of the channel, and the hauling part goes through a block strapped to the other eye, then in to the pinrails. The topping lifts are single, passing through blocks seized to the spreader at the masthead. The ends have single blocks and whips to the deck and pinrails. The stunsail booms can now be rove through their irons to extend a little beyond and have their inner ends lashed to the yards.

The topsail yard is held to the mast with a lashing through two eyebolts in the saddle and is raised with a chain tie passing through a hole at the masthead and down abaft to a double block, with another in the waterways on the port side, so that the end comes up to the pinrail. At the yardarms, brace blocks are strapped on first. The ends of the braces are seized to the eye of the mainstay, lead through the yardarm blocks, back through double blocks strapped to eyes at the sides of the main cap, and to the pinrail. The lifts are single, spliced to the yardarms, and seized to the eyes of the rigging. Sheet blocks are used as before.

The topgallant yard has a similar parrel to the topsail yard. The halyard is a rope from an eye in the yard, through a hole in the masthead, and down on the starboard side to a single and a double block. The lifts and braces are as before.

I gave my model such sail gear as would be left rove off during a short stay in port. The topsail sheets start with an eye splice, reeve through the yardarm blocks mentioned, along under the yard through blocks strapped to them amidships, and down with single blocks and whips to eyes in the deck, the end going through the forward posts of the fiferail. The clew lines start at the heel of blocks strapped under the topsail yard, through hook blocks hooked to the sheets, back through the upper block, and to the pinrail. The topgallant gear is similar, except that the clew lines are single. Two buntline blocks can be seized to the topsail-yard jackstays, and one to the topgallant.

The staysail and jib halyards have their ends seized to the eye of the forestay, lead through blocks hooked to the top bank, and back to blocks seized under the crosstrees—staysail to starboard and jib to port. The downhauls hitch to these blocks and lead through blocks seized to the stay at the jib boom and in to the forward pinrails.

The gaff topsail gear consists of a halyard, the end of which is seized to the eyes of the rigging, goes through a hook block, back through a hole in the masthead, and to the deck. The downhaul hitches to this block and leads through a small block at the cap to the deck. The sheet also hitches to the block, leads through a hole in the gaff end, through a block under the gaff, and to the deck.

The ringtail, if used, is set like a stunsail. The yard hoists on the peak downhaul to the peak, and the boom lashes to the main boom, or has an iron like the other stunsails.

Coils of rope on the belaying pins give a good finishing touch. (*Continued on page 97*)

Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

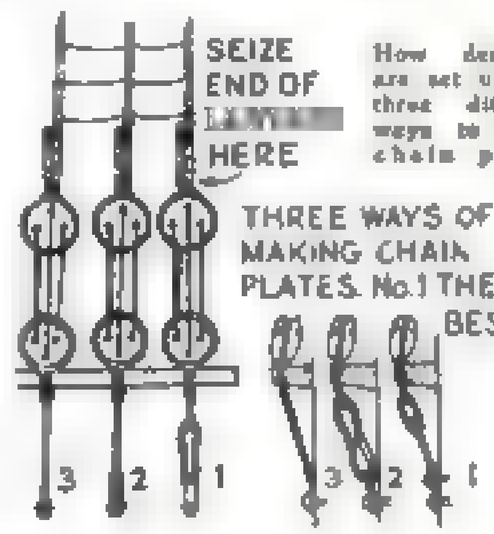
RIGGING THE *SWALLOW*

(Continued from page 96)

These should, of course, be the actual ends of the ropes, but I find it easier and neater to belay the ropes by taking a turn under the pin, then throwing a hitch (with the tweezers) over the pin and cutting short. I then make coils of the same size rope on a stick, tie them with one turn of silk, and glue them in position.

Two wood-stock anchors about 1 in. long are needed with chain cables of about eleven links to the inch. The rings of these are hung to the catheads with the stoppers. Cords with a knot, go through the catheads, through the ring, and fasten inboard to a cleat or ring in a timberhead. The flukes are held level with the rail by the shank painters—cords or chains around the crowns, fastened to bolts in the waterways.

The cables lead through the hawse pipes along the deck, under the ends of the cable bitts, over the uprights, under the ends, and along the deck to the chain pipes. The stop-



How deadeyes are set up and three different ways to make chain plates

pers are short ropes with a big knot in the ends, seized to bolts in the deck. The chains are lashed to these to hold them back.

This vessel should have several boats, but they clutter up the deck so much that I gave her only the jolly-boat under the stern. It is 2 in. long and 5/8 in. in beam and is hung with a double block hooked at each end, the fall being rove through these and the sheaves in the stern davits and belayed to cleats or to the pinrails. To make her hang properly, suspend a weight from the boat and then dope the falls until stiff.

The tiller ropes start from a bolt at the side, through a block seized to the tiller, back to a bolt at the side, through a ring under the tiller, and the same on the other side, thus forming an endless tackle.

These vessels were not entitled to pennants, but usually flew them, so I gave her a red and white one. The ensign of the 18.2 period has thirteen stars and thirteen bars. These hoist on halyards of thin silk.

The trucks are little balls. I bored mine first, then shaped them with a file, and applied gold leaf. You can add a small weather vane arrow at the main if you like. A jack can be flown on a short staff at the bowsprit cap. This is stepped in two little staples at the side of the cap.

The base can be any of the approved forms. I used graving-dock blocks. Screws are driven through two of these, up through the keel and into the hull. The blocks are then screwed to the baseboard, which is 4½ by 13 in. The other blocks are merely fitted in place and glued. A shore will be needed on either side to take the strain off the keel. I bored right through the base, at an angle, then pushed them up and toenailed them.

Remember that the water line must be horizontal, that is, the keel will be 3 16 in. higher at line III than at line XI.

This completes our little *Swallow* model.

Secrets of Success

STORIES THAT WILL HELP YOU GET AHEAD

THINK THIS OVER

The other day when I was opening up my morning mail I found a little folder enclosed with my life insurance premium notice—a polite request for the name of anyone who I thought would be interested in selling life insurance. I did know of a young man who I believe could make a go of it, so I filled out the blank and sent it along.

Having finished my routine mail I settled down to read a batch of "Secrets of Success" stories that had come in that morning. Well, believe it or not, but there was the most unique and varied collection of ideas for making money that I had seen for a long time. Those readers had good, workable ideas on everything from insect culture to sculpturing in concrete. I almost forgot that I was a hard-boiled contest editor—I had become so interested.

But I am only human, and I supposed my mind wandered for a moment, but I got to thinking about that little life insurance folder again. Did I know of anyone who I thought could make good selling life insurance? Why I knew of hundreds of them—only I was not free to send their names! Practically every one of those entrants in the "Secrets of Success" contest had just the very qualities that make a successful life insurance salesman—initiative—originality—energy. Now I wonder if this same thought has occurred to any of you?

Life insurance selling has always offered exceptional opportunities—from now on even greater possibilities await the wide-awake salesman. Conditions during these past few years have done much to make people realize the importance and the desirability of life insurance. From all indications, the life insurance business is about to enter a period of greatly increased prosperity. Thousands of policy holders who found their life insurance an invaluable asset during the lean years will soon be ready to buy more, now that they are getting back on their feet. Thousands of others, who wish they had fortified themselves with this safe form of investment, will be in the market as times continue to improve. It certainly looks as though life insurance is going to be a mighty good thing to sell!

Of course, it is not my idea to persuade anyone who is happy in his job, and making a satisfactory living, to "chuck" it and go into the life insurance business. But, judging from the ideas that come in these "Secrets of Success" stories, all of these readers are giving some mighty serious thought to the business of earning more money. Sometimes, when we are thinking very hard about some knotty problem, it is easy to overlook the simple solution. Perhaps life insurance is the solution for you. So take this suggestion merely as a reminder to check up on what life insurance has to offer you.

Secrets of Success

STARTS BUSINESS WITH STAMP COLLECTION

WHEN the firm by whom he was employed became bankrupt, a young business man whom I know was thrown out of work and most of his savings were swept away. Being interested in philately he decided to turn his hobby to good account by establishing himself as a dealer in postage stamps.

His stock in trade consisted of an accumulation of duplicates, mostly of little value, an amateur's knowledge of stamps and the stamp trade, a fair business training and two hundred dollars cash, available for the venture.

He first budgeted his capital about as follows: advertising $40.; stock and supplies, $90.; postage, printing and other office necessities, $20.; reserve balance, $50. A room in his home was turned into an office; a rented typewriter completed his equipment. He, of course, was his own stenographer.

For advertising he selected one popular trade weekly and one boys' weekly. He inserted a small classified advertisement in each for four issues. The advertisements featured an offer to send, postpaid, a packet gloriously designated as a "humdinger", consisting of 100 assorted foreign stamps, a perforation gauge and a small pocket album, all for ten cents. He purchased from a wholesale house sufficient quantities of each item to make up 250 packets. These cost him six cents a packet. The balance of his stock and supplies budget he invested in stamps of better grades, approval sheets and books, and minor accessories.

By the time the first advertisement appeared the humdinger packets and a quantity of approval sheets were ready. Replies came in encouraging numbers, and in each envelop ten cents was enclosed. When he mailed the humdinger packets, he enclosed in each one a prize packet of five stamps with pictures of animals, birds or boats—these being chosen to appeal to juvenile collectors. The individually typed letters, that accompanied each mailing, requested the recipient to send the names and addresses of three other collectors. When the returns from this prize packet appeal were complete a mailing list of five hundred active collectors had been accumulated, including the names obtained from the Humdinger offer. Both of these offers had been made merely for advertising purposes so of course but little cash profit resulted.

The profitable business soon began to arrive in the form of orders for better grade stamps selected. The demand for books of better grade stamps increased. Some of these were available in the stock already purchased, others he obtained on credit from a wholesale house. Although some of the collectors, to whom stamps

Secrets of Success

STARTS BUSINESS WITH STAMP COLLECTION

(Continued from page 99)

were sent on approval, were dishonest or careless in making returns, most of them were profitable customers who spent from a few cents up to two or three dollars at a time. Later he added special packets made up by countries and sets to his stock. The unsatisfactory customers he weeded from the list and experience soon taught him how to reduce other leaks.

In a few months the business was earning a satisfactory profit. On one red-letter day, he sold a miscellaneous lot of about 8000 different stamps for $300.

This sale was particularly interesting because of the fact that it brought a return, fifty per cent greater than the entire amount originally invested in the business. That, you will agree, was quite a record to set up within a few months of the launching of the enterprise. Of course, such a large sale is uncommon but the number of sales to small collectors has increased steadily until quite a sizable volume has been reached.

This business, which started so modestly, enabled this young man to become master of his own time. The work is congenial interesting and instructive and has proven more gratifying than the position he lost.—J. H. H., Narberth, Penna.

Cash Prizes

THIS department will give $5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City

Old Bill SAYS:

A CYLINDRICALLY ground bar ¾ in. in diameter and 15 in. long, used in connection with the dial indicator, serves well to test the alignment of lathe centers and any other such jobs around the shop.

To prevent distortion in bending small aluminum and copper tubing, it helps materially to close one end in the vise, fill with heavy oil, and close the other end.

It may cost as much as the price of a file to have a tool chromium plated, but it will last from five to six times longer, even on hard castings.

A surface milled with a tungsten-carbide cemented cutter will be 100 percent smoother than when ordinary tools are used. This result is due to the high speed obtainable while much less heat is conducted to the work.

When individual wrenches are loose because of wear, heat and close them up to size. This will save you much time and possibly some sore knuckles.

Discarded taps with centers make good grinding arbors in an emergency by grinding off the thread free-hand, then grinding to size on centers.

While the 118-deg. angle of a drill is recognized as standard, a 135-deg. angle will work better in drilling high-carbon alloy steel forgings and other hard materials.

Number drills ground to a spherical nose will serve as reamers to remove a few thousandths from a hole.

Lathe collets can be made to give added service by slitting them with a flexible rubber grinding wheel the length of the thread that has become worn, and pressing in a soft bushing with a 1/16-in. wall and about .015 in. larger than the hole in the collet.

GASKET CORK IMPROVES TABLE TENNIS BATS

Good table-tennis bats are expensive, and homemade ones of plywood with broomstick handles, even when faced with sandpaper are not altogether satisfactory. An excellent solution is to buy a sheet of gasket cork at an auto supply store for facing the bats. I paid only 11 cents for a sheet of cork 18 by 30 in. Give the bats one good coat of shellac on both sides, and the cork pieces on one side only. When the shellac has dried just enough to be very sticky, apply the shellacked side of the cork to the bats. The cork is then trimmed with a razor blade and the edges are beveled, after which the edges are smoothed with sandpaper.—F.M.

STANDARD

Ship Model Kits

Designed to save your time

KIT Q

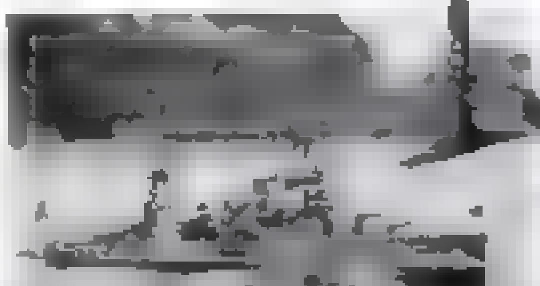
KIT D

KIT G

KIT A

NO. 2

NO. 4



KIT E

F[illegible]

[illegible] manship. Each of them requires a [illegible] different kinds of hard- [illegible] day's time and would have to buy much larger quantities than you have any need for. Besides, you will probably have to take some substitutes that will be harder to work with and will not give as good results in the finished model.

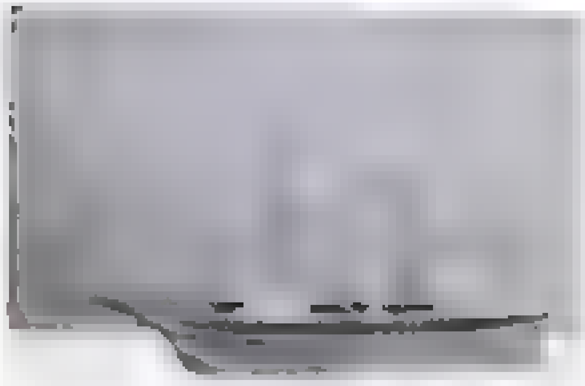
The kits contain only the raw materials, but everything is of the best and is exactly suited to the particular model in which it is to be used. The strips of wood, for example, are cut to the correct width and thickness—in itself a considerable task. Wire, rigging cord, brass, fiber, celluloid, chain, tubing, and the like are all of the right size and quality.

The Historic *Hartford*—Kit L

Note in the following list that all but one of the standard ship model kits can be obtained with plain boards or blocks for the hull, or with them sawed out or shaped from our own master templates. Those who have jig saws or band saws can do the shaping themselves without difficulty, otherwise it is a distinct saving in time to have this work done for you, especially as the charge is a nominal one. In the case of the *Swallow*, which is the smallest ship model in this classification, all the kits contain sawed-out hull boards.

The easiest of our models to make are those designed by Theodore Gommi for the Popular Science Model-of-the-Month Club. They are beautiful little water-line models, made of balsa wood, and can be put together with no other tools than a pocketknife, some razor blades, and a pair of pliers. These kits contain all the raw materials, paints, blueprints, and instructions. This month's model is the *Hispaniola* of "Treasure Island" fame.

The simplified ship model kits form a third



KIT J—Materials for a simplified clipper

and intermediate classification. They are of the same general construction as our standard models but are very much smaller and require much less work. In these kits the hulls are furnished roughly shaped.

STANDARD SHIP MODEL KITS

- **A.** Whaling Ship *Wanderer*, 20½-in.....$6.90*
- **AA.** Same with hull lifts sawed..... 7.40*
- **D.** Spanish galleon, 24-in.........6.45*
- **DD** Same with hull blocks shaped.. 6.95*
- **E.** Battleship U.S.S. *Texas*, 3-ft 6.45*
- **EE.** Same with hull lifts sawed 7.45*
- **G.** Elizabethan galleon *Revenge*, 25-in. 6.[illegible]*
- **GG.** Same with hull blocks shaped ..... 7.[illegible]*
- **L.** Farragut's flagship *Hartford*, a steam and sail powered war [illegible] hull ..... [illegible]*
- **LL.** Same with hull lifts sawed 8.45*
- **Q.** Privateer *Swallow*, 17½-in. hull, with lifts sawed to shape........ 4.95*

MODEL-OF-THE-MONTH KITS

- **M.** Aircraft carrier *Saratoga*, 1[illegible] in. 1.00
- **N.** Four U. S. destroyers, each 6[illegible] in. ..... .75
- **O.** Liner S. S. *St. Louis*, [illegible] ..... 1.[illegible]
- **P.** Cup yacht *Rainbow*, [illegible] ..... .75
- **R.** U. S. cruiser *T*[illegible] 1.00
- **S.** [illegible] steam tug [illegible] and [illegible] (two models in one kit) ..... .75
- **T.** U. S. S. *Brooklyn*, armored cruiser in Spanish-American War, [illegible] ..... .75
- **U.** *Hispaniola*, the ship in "Treasure Island," [illegible] ..... .50

SIMPLIFIED SHIP MODEL KITS

- **F.** Liner S.S. *Manhattan*, [illegible] ..... [illegible].00
- **H.** Cruiser U.S.S. *Indianapolis*, [illegible] 1.50
- **J.** Clipper ship *Sea Witch*, [illegible] 1.50

FURNITURE KITS

No. 3. Solid mahogany tray-top table [illegible] in. high with a [illegible] top. Ready to assemble, but without finishes........ $3.40*

No. 4. Solid mahogany book trough [illegible] in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble, with finishes........ 5.30*

No. 5. Solid rock maple hanging wall rack with one drawer, 19½ in. wide, 33½ in. high. Ready to assemble and stain included........ $.75*

No. 6. [illegible] rock maple butterfly table top [illegible] Ready to assemble and stain included. 6.90*

Note: If you live west of the Mississippi River add [illegible] marked with an asterisk (*) because of the heavy [illegible] charges. [illegible] The kits marked with an asterisk will be sent C. O. D. upon request, but the purchaser will have to pay [illegible] additional [illegible]

Popular Science Monthly
381 Fourth Avenue, New York, N. Y.

Please send me Kit .... for .... which I enclose $ .... (or send C. O. D.).

Name ....

Address ....

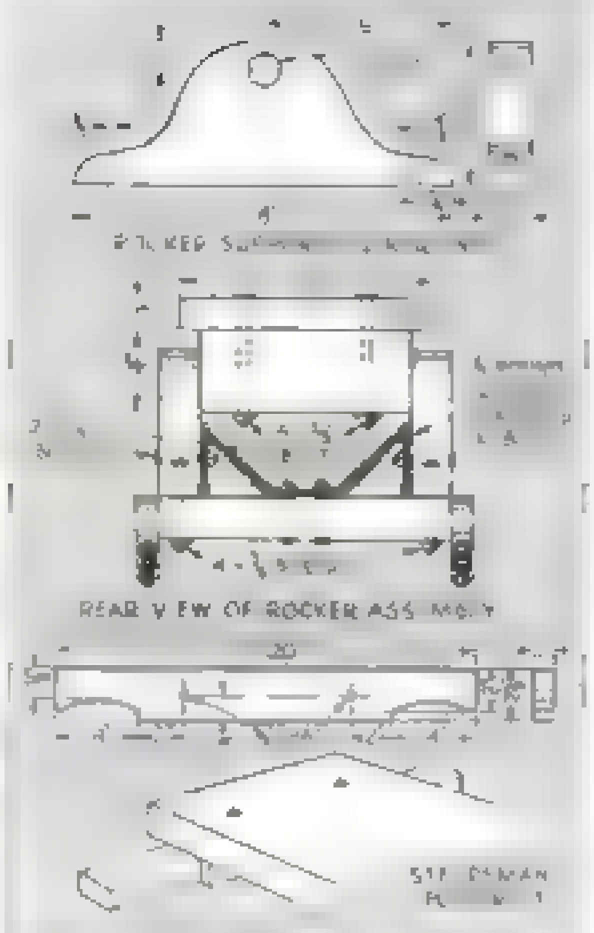
City .... State ....

Print name very clearly.

Please remember that no kits can be sent C. O. D. except as noted above. This offer is made only in the United States.

HOW TO BUILD A LARGE BOBSLED

(Continued from page 67)



Rocker supports for the rear sled, how they are fastened and braced, and the foot rest

put on until the bobsled has been painted.

After the rocker and rocker supports are in place the supports must be braced with iron rod as shown. This brace is 30 in. long, flattened at one end for 3½ in., bent at an angle of 45 deg. and, beginning 5 in. from the bend, flattened again for 3 in. At the 5-in. point, bend to 135 deg., and at the end of the flat, to 135 deg. again. Measure 5 in. from this last bend and flatten again for 3½ in. and bend to 45 deg. Drill a ¼-in. hole in the middle of each 3½-in. flat and two holes in the 3-in. flat. Place this between the two rocker supports, and bolt to the supports and cross brace with 2½ by 5/16-in. bolts.

The spruce seat should finish about 1½ by 12 in. by 11 ft., with the rear end cut to a semicircle (or curved to some degree) and the front end square. The top half of the turntable is placed 12 in. from the front end, but before it is bolted, the 10-in. pivot bolt is inserted. Bore a 1-in. hole in the center of the turntable deep enough to allow the head of the bolt to drop just below the surface. Using the same center, bore a ½-in. hole the rest of the way through.

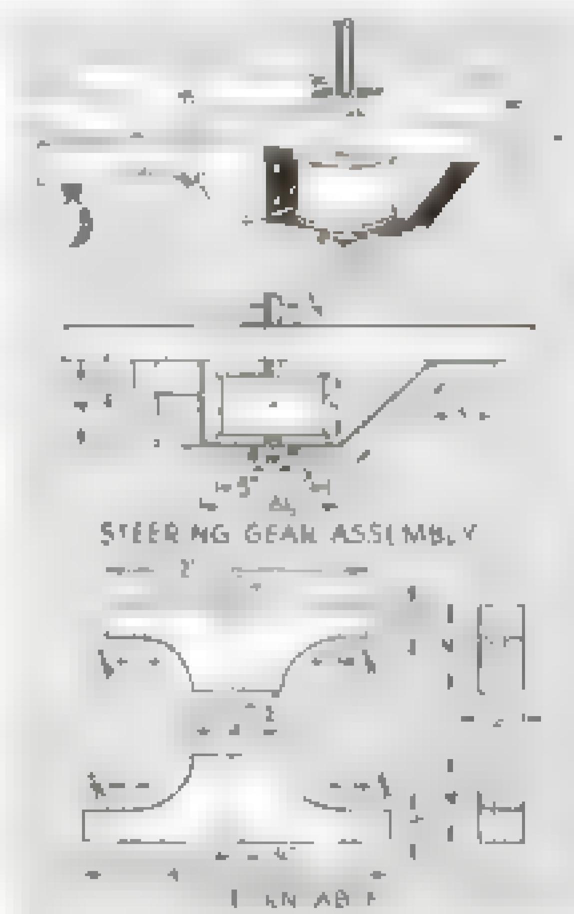
With the bolt in place through both halves of the turntable, turn the nut up on the lower end until about 1/16 in. from the wood. Mark the place, remove the bolt, and with the nut up to the marked place, drill through nut and bolt for a cotter pin. Put the bolt through the top half of the turntable and bolt this half to the seat. It is then braced to the seat at the front with a piece of iron rod flattened at both ends and bent to make an angle of 45 deg. between seat and upright. The front end is bolted to the seat, but the other end is put on with screws as the pivot bolt prevents bolting this end.

The footrest for the steersman is cut as shown and bolted to the front end of the seat on the underside. A piece of softwood about 1 by 1½ by 18 in. is fastened to the underside of the seat between the turntable and the iron brace for holding two pulleys.

The steering gear will entail a trip to a machinist unless you happen to have a metal lathe, taps, and dies. The spool may be wood or metal, 3 in. long, 3 in. in diameter, with a ¾-in. hole through it for the shaft. If metal, it is fastened to the shaft with a key or set screw; if wood, with a pin or bolt. Be sure there are no projecting ends for the rope to catch on.

The shaft is about 13 in. long over all, with the lower end turned down to ½ in. in diameter for about ½ in. and threaded to receive a nut. The nut is put on, leaving a good 1/16 in. between it and the shoulder, and both nut and shaft are drilled for a cotter pin. The spool is placed on the shaft so that there will be about ¼ in. of the shaft projecting below.

The steering gear support also serves as a brace for the turntable. It is made of 2-in. flat iron with three bends—the first 4 in. from one end, the second is 6½ in. from the first, and the third is 3½ in. from the second. The first bend is 90 deg., the other two are each 135 deg. A ½-in. hole is drilled through the center of the 6½-in. length, and the iron is cut off 3 in. beyond the last bend. Four screw holes are drilled and countersunk in the 4 in. surface, and a ¼-in. hole for a bolt



Method of mounting the steering drum and pulleys, and layout for the turntable parts

is drilled in the 3 in. end. The 4-in. end is fastened to the rear of the turntable, and the other end bolted to the seat board.

A ¾-in. hole for the shaft bored through the seat directly over the ½-in. hole in the support. This will be stronger if a short piece of the 2-in. iron is also drilled ¾ in. and placed around the hole.

The seat is now fastened by inserting the pivot bolt in the lower half of the turntable and bolting the rear sled rocker to the plank. The rocker should be placed about 2 ft. from the extreme rear of the seat.

Bore a ¼-in. hole through the toe end of each forward runner, just inside the irons, for the steering rope. To hook up the rope, tie a knot in one end and pull the rope through one of the ¼-in. holes (from the outside towards the center) and pass it through the pulley on the opposite side. Continue on around behind the spool, taking one or two turns around the spool, and bring the end back through the other pulley and out through the remaining ¼-in. hole. Pull the rope as tight as (Continued on page 105)

BOBSLED BUILDING

(Continued from page 104)

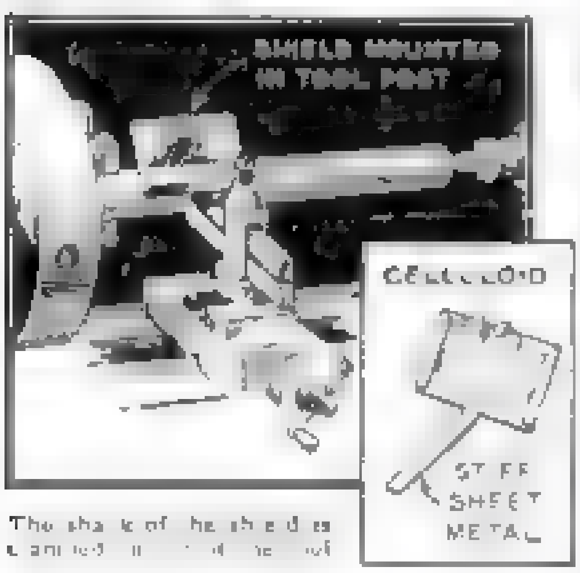
you can and tie a knot securely in the end.

The entire sled should be given three coats of paint, preferably bright colors such as red, green, or blue. After the paint is dry, the runner irons are put on and polished with emery cloth and steel wool.

If running boards are desired, they can be made of softwood about ¾ by 3½ in. by 10 ft., and braces can be made by bending and flattening the ends of ½-in. round iron. The braces, four to a side, are bolted to the underside of the seat, and the running boards are bolted to the braces.

SHIELD PROTECTS EYES WHEN TURNING BRASS

TO SAFEGUARD my eyes from chips when turning brass, I use a shield made as illustrated. Brass, tin, or other stiff sheet metal will serve for the frame. This is fitted with celluloid from an old side curtain or with isinglass. Glass also may be used, although it is more likely to be broken. The shank of the shield is mounted in the tool post directly on top of the tool, and the screen is set quite close to the work. I have used such a shield for about thirty years, yet it has been regarded as a novelty in each shop in which I have worked.—ANTON HECKEL



The shank of the shield is clamped in [illegible] the tool

ENLARGEMENTS SOFTENED WITH SHEET OF GLASS

BY WABBLING a sheet of glass between the lens of an enlarger and the enlarging easel, the amateur photographer can easily make soft-focus enlargements. The effect of the glass, which should be held 4 or 5 in. from the lens, is to give a result that resembles photos produced with the aid of a costly soft-focus lens.—ROBERT J. BLOSSER

ALCATRAZ—AMERICA'S DEVIL'S ISLAND

(Continued from page 21)

of incarceration. Nor can any prisoner receive mail directly. Each letter is copied by a guard to avoid the possibility of hidden writing or code messages slipping into the prison. When a felon is permitted to receive a visitor, he and his guest sit in separate rooms and talk through a perforated bullet-proof glass set in the center of a thick wall. The perforations are too small to permit the passage of any objects.

Suppose we follow a prisoner into the walled island. He arrives with several other notorious offenders in a Pullman car ferried across San Francisco bay on a barge. Secret service men stand guard within the car at both ends and outside on the barge. The sixty-five-foot prison launch, manned with sharp-shooter guards and flanked by coast guard launches, parallels the barge as it approaches the island. Once it docks, the armed launches stand out a hundred yards, guns ready for service.

FOUR towers, reached by high catwalks from the prison wall, command a view of the entire island. As the guards keep sharp lookout, the prisoners ascend the cement walk and enter the outside solid steel door. Then they pass a bar door, next another solid door containing a slitted opening through which the guard inspects them, and finally through a fourth door of solid steel. The outer door remains open during the day, but no two of the other three may be opened at any one time. When lock-up time arrives in the evening, the outer door swings closed and may not be opened except by the warden or his first deputy until morning.

After the usual receiving routine and issuance of clothing, the prisoner is led to his cell, a tiny room four feet wide and eight feet long. He finds himself on one of three tiers in the high, cathedral square cell block. As he looks through the bars he notes that nowhere is a hiding place. He finds in his cell no tools which might be refashioned to aid an escape. Each cell contains a steel cot that folds against the wall, two arms of sea-like size, besides a narrow shelf containing three riveted hooks for clothing, a toilet, and a small basin. Aside from these conveniences, the prisoner is permitted two towels, tooth powder and brush, and a cup.

The barred cell doors are operated from twenty-four boxes. At both ends of the cell room are barred corridors patrolled by armed guards. There is no possible access from the corridors to the cell room and, like the prisoners, guards are locked in until relieved. On the ground floor and in the cell blocks, guards move unarmed among the prisoners. This helps prevent acquisition of firearms by prisoners.

While outlawed by society, the felons receive excellent care and treatment so long as they maintain prison peace. On the second floor are a surgery and dental laboratory, with federal doctors available. In the surgery are two barred one-bed wards for patients who cannot be trusted with another in the absence of a guard. At the opposite end of this floor are the assembly hall, with stage and piano. Next is the library. In the basement are the barber shop, showers, and storerooms.

ALTHOUGH the cell blocks occupy only a small part of the island, elaborate works have been set up outside to prevent escape. Surrounding the prison building is a twenty-foot wall. Whenever prisoners are led outside the walls for work in buildings at the opposite end of the island, they march between guards on the walls and within the guard towers, but they are still confined within a cyclone fence and barbed wire entanglements spread along the rocks between the crest and the water line. Even the gates through which they pass are controlled from a high tower forty feet above their heads.

Although Alcatraz is considered to be the most nearly escape-proof prison ever devised, the radio transmitter, installed a few weeks ago by coast guard forces, flashes its daily call to the coast guard station at Point Bonita, six miles distant. Across those six miles one day may flash the warning that some public enemy has escaped. The warden maintains telephone lines to Forts Mason and McDowell and the Presidio at San Francisco, yet should a wholesale delivery attempt involve cutting the telephone cable, the prison operator, safe within his barred radio room, can send the equivalent of an S O S to KGPD, the San Francisco police department's station.

UNTIL recently the army used Alcatraz as a disciplinary barracks. Though surrounded by water, several desperate prisoners have attempted escape in years gone by. The first escape occurred in 1862 when three prisoners from the California volunteers filed their chains, cut their way out with a hatchet, lowered themselves from the north battery by a rope, walked around the island to the dock, and fled in a confiscated boat. Several others forged pardons and walked out through the front door. In 1908 one man escaped by boat. Four years later two sawed their way out, but were found several days later, nearly starved, underneath one of the prison buildings. During the last twenty-five years, twenty-five military prisoners have escaped, but not one of these swam away.

No prison in history has been so well fortified and so well manned as the new Alcatraz. Not only can a powerful combination of military, naval, state, and federal forces be converged in a few minutes toward the prison, but the guards themselves are Uncle Sam's best. Warden Johnston visited prisons at Atlanta, Leavenworth, Lewisburg, and McNeil's island to hand-pick veterans who already had proved their calm judgment, bravery, and intelligence. Then he sent them to school at McNeil's island where they received special instruction in every phase of safe-guarding the world's toughest criminals. They are today skilled boxers and wrestlers, expert in use of fire arms and proficient in jiu jitsu.

Warden Johnston, gray haired and small of stature, knows his prisons and their inmates. He was thrust suddenly into the wardenship of Folsom Prison, which houses California's three-time losers and lifers, while chairman of the State Board of Control in 1913. Prisoners were in revolt, but in a short time Johnston abolished corporal punishment, improved the discipline, and attempted prison breaks and riots ceased.

The following year he was moved to San Quentin Prison where, until his tenure ceased in 1925, he sought to reform the inmates and give them work to do, thereby taking their minds from plot-hatching.

UPON him and his forty guards rests the responsibility of keeping secure such notorious underworld characters as Al Capone, until his imprisonment the nation's "ace enemy", George (Machine Gun) Kelly, Harold Fontaine, smuggler of guns for the Leavenworth break in December, 1931, Harvey J. Bailey and Albert Bates, who kidnaped Charles F. Urschel, Oklahoma oil man, Thomas Underwood, Charles Berta and Stanley Brown, who helped abduct Warden White of the Leavenworth prison in the break three years ago; W. D. May and O. D. Stevens, who slew three Texans and, for good measure, held up a train in 1933, making off with $72,000.

CHEMICAL STUNTS WITH CHROMIUM, MANGANESE

(Continued from page 45)

and expose it to the light. Naturally, the compounding of the mixture and the drying as well as the application of the negative must be done in the dark.

After several hours of exposure, remove the negative and immerse the card in water. Strange as it may seem, the portions exposed to the light will remain black while those covered by the dark areas of the negative, or opaque cut-out figure, will disappear.

THE explanation is a simple one. On the portions exposed to the light, the glue is rendered insoluble by the ammonium bichromate and holds the lampblack particles while on the covered portions, no change takes place and the glue is readily dissolved.

Because of the amount of oxygen it contains, lead chromate also is valuable as a test material for organic substances such as starch, sugar, or coal. Mixed with an equal amount of coal and heated in a test tube, for instance, it proceeds to oxidize the carbon to form free carbon-dioxide gas. The presence of carbon dioxide can be shown by bubbling the escaping gases through lime water or barium hydroxide solution. A characteristic white precipitate will be formed.

Our first contact with the compounds of manganese came in our early experiments with oxygen (P. S. M., June '32, p. 64). In the preparation of oxygen, potassium chlorate was heated in the presence of manganese dioxide. Although the manganese dioxide did not enter into the actual reaction, it served to liberate the oxygen at a lower temperature.

The home chemist can again make good use of manganese dioxide to compound a mysterious mineral chameleon in the form of a chemical that changes its color as if by magic. First of all, mix some manganese dioxide with solid potassium hydroxide (caustic potash) and a small amount of potassium nitrate and heat the brownish-black powder that results on a flat tin-can top held over your laboratory burner. When it appears dry, allow it to cool and finally stir it into a beaker of water. With each precipitation of the various oxides of manganese, the liquid will appear first green, then red, and finally [illegible].

POTASSIUM permanganate is not only one of the most colorful of the manganese compounds but it also claims the distinction of containing more available oxygen than any other substance. These characteristics give it a place among industry's useful chemicals. Its high oxygen content makes it valuable as a germicide while its color makes it useful as a stain for wood, animal, and vegetable matters as well as metals and cements.

Its large oxygen content also made potassium permanganate valuable in the World War. Based on the fact that strong glycerin takes fire if it is poured over potassium permanganate crystals in the presence of sulphuric acid, unique smoke alarms were arranged to warn soldiers of the approach of enemy troops. Thin glass tubes were filled with glycerin, sealed, and placed in a slightly larger glass tube containing powdered potassium permanganate. This tube in turn was inserted into a third tube containing five parts of sodium nitrate, two parts of sulphur and one part of antimony sulphide.

In use, these bombs were hidden in the soil and grass at strategic positions. When tramped upon the three tubes were broken, the glycerin was ignited by the potassium permanganate, and this fired the antimony-sulphur mixture to produce quantities of smoke. In this way any activities of hostile soldiers was immediately made known.

CAN SCIENCE RAISE THE DEAD?

(Continued from page 13)

taining one part epinephrine in 1,000. Five minutes after the man had collapsed, the solution was shot directly into the left ventricle of his heart. The effect was almost instantaneous. Within thirty seconds the man had begun to breathe and his heart had resumed beating.

Since then such wonders have become commonplace. Hundreds of persons have been saved from death—men and women who had collapsed while undergoing operations, infants apparently stillborn, and persons seemingly shocked to death by electricity. The method employed has become standard practice in hospitals and has sometimes been put to surprising uses, as at Detroit not long ago.

ONE of a fleeing gang of bank robbers had been shot by police. The wounded man, apparently lifeless, was taken to a hospital and given a shot of adrenalin. He regained consciousness long enough to give police the names of his companions.

In no case, however, where a human being has been revived could physicians assert positively that the subject had actually died. This is not strange because no one as yet can say just when a body dies. There is, it appears, no such thing as sudden death.

It is sometimes supposed that life ends abruptly, like an electric light switched off. Actually, death is a slow and gradual process, like the breaking up of a vast colonial empire. The capitals, the brain and heart, die first. Cells elsewhere in the body, which may be compared to colonies, do not immediately expire. They are but doomed to eventual destruction. No more supplies in the form of oxygen arrive from the capitals. No reinforcements come to help them fight off destructive chemical changes and bacteria.

The cells themselves might, if nourished, continue not only to live but to multiply. Twenty years ago, scientists at the Rockefeller Institute placed a fragment of living tissue from the heart of a chicken in a culture solution. Today the fragment still lives. In England, another experimenter placed a minute particle of a frog's spinal marrow in a test tube of similar solution. The particle lived for fifty-eight hours and increased its size hundreds of times. More recently, English scientists have shown that living cells taken from animal skins and placed in suitable culture can be made to grow hair or wool indefinitely.

It is difficult, therefore, to determine just when life ceases in the human body and death begins. The customary tests, short of opening an artery, are not infallible. Stoppage of the heart and cessation of breathing, although they always accompany death, are not always proofs of its occurrence.

An incident that took place in London shows how certain diseases and seizures such as catalepsy and shocks can leave a person so nearly dead that medical examination sometimes fails to detect the presence of life. A boy was picked up for dead in a park and hurried to a hospital. A certificate of death was issued and the body removed to a mortuary. After a time the boy's mother arrived. She scolded indignantly when attendants told her the boy was dead and, to their consternation, displayed three previous death certificates for him. Later the boy was revived and walked home with her.

EVEN persons in perfect health have been known to simulate death. In a celebrated exhibition at Lahore, India, a *fakir* named Haridas went voluntarily into a trance that convinced witnesses he was dead. He was sewn into a bag, placed in a dead box and buried in a grave several feet deep. Sentries stood guard over the grave for forty days. The *fakir* was then exhumed, his eyes and mouth moistened with water. After a few moments he sat up and asked for food.

Under the necessity of discovering some means of detecting death with absolute certainty, many methods, some gruesome, have been evolved. One is the extremely sensitive instrument known as the electrocardiograph. When applied to the chest, this device indicates the slightest flutter of the heart. An electrical test was discovered about three years ago by Dr. George W. Crile, of Cleveland, Ohio. Body cells, he established, maintain an electric charge through chemical action. In death, this charge falls to zero. A French physician, Dr. Icard, injects a yellow dye into the veins of the person supposed to be dead. If the subject is in a trance, the feeble circulation that persists in the body carries the dye to the lining of the eye-lids, coloring it yellow.

BEFORE the development of these tests, people were periodically swept with panic at the thought of premature burial. A quarter of a century ago, *Le Figaro*, the Parisian newspaper, cited during its crusade for more stringent tests 400 cases of supposed premature interment. As late as 1896 an English writer collected evidence of 700 such cases.

The awe in which death was held by ancient peoples was inspired not by fear of revivification but by the mystery and inevitability of death itself. Hedged about by superstitions and religious taboos, primitive men had no desire to see the dead restored. They believed that to interfere with the dark processes of death was to court fearful evils. Even the intellectually advanced Greeks of the Homeric era held such a belief. Aesculapius, the mythical hero who was the world's first physician, became so skilled in postponing death that he dared once to revive a dead man. As punishment for his effrontery, Jove cut short his supposedly immortal life with a thunderbolt.

As fear of spirits waned, instances of altered traditions appeared among the Greeks and Hebrews. Empedocles, a Greek philosopher of the fifth century before Christ, is reputed to have revived a dead woman simply by bidding her to rise, and Apollonius of Tyana, a mystic who lived just before the Christian era, resuscitated a young girl in dramatic fashion as she was being borne to the funeral pyre. The Hebrew prophet Elisha raised the son of the Shunammite woman by breathing into his mouth and praying over him. In the New Testament, accounts of similar incidents are numerous.

DURING the Middle Ages, men believed earnestly in the power of the Christian saints to restore life. St. Francis of Paula, in the fifteenth century, achieved the distinction, according to contemporary accounts, of twice raising the same man from the dead. In chopping down a tree, the man one day misjudged the angle of the tree's fall and was caught beneath its bole and crushed to death. St. Francis revived him. Determined not to run further risks of the kind, the man unluckily chose to become a steeplejack. He slipped from a steeple and crushed to the ground, killing himself a second time. Again St. Francis restored him to life.

In modern times actual restoration of life has come to be regarded as an impossibility. Many scientists regard Dr. Cornish's intention to apply his methods to a man as fantastic and say he cannot succeed. Besides many legal and moral obstacles stand in the way of such an audacious undertaking. Yet results to date have been incredible. They have quieted many fears and have shed new light on some of the mysteries of death. Science seems determined, if not now then some day, to cheat the grave.

SCIENCE TURNS HOCKEY INTO BIG BUSINESS

(Continued from page 57)

minor leagues organized as "feeders" for the big-time circuits, professional hockey has entered the realm of Big Business.

Called "Sport's fastest growing boy," it promises to dot the country with rinks. For, with the latest systems of speedy refrigeration, ice hockey is possible in southern as well as in northern states. In fact, one active league on the West Coast has its center in Los Angeles, in Southern California.

George C. Funk, Boston ice engineer who built the first modern rinks in that and other large American cities, and James E. McNally, veteran superintendent of Madison Square Garden, are largely responsible for the advance. It was McNally who devised the high-speed system of disposing of the ice after a game which has made hockey possible in arenas like the Garden.

On a single week's schedule for such an auditorium there may be a prize fight, a flower show, a track meet, a symphony concert, a motorboat exhibit, and a pageant with hockey games sandwiched in between. The ice for the matches has to appear and disappear as though by magic.

EVEN before the last straggler has left the Garden on the night of a hockey game, McNally's magic begins to work. The brine, which has been running through the inch-and-a-quarter pipes at a temperature of fifteen degrees F., is passed through a steam heater. Its temperature rises to seventy degrees and in a few minutes the lowest layer of the ice, next the concrete, is melted.

Motor-driven plows then head across the floor ripping up strips of ice a yard wide and leaving them, as fragments, in long windrows behind. Other electric-powered machines follow and shove the windrows into piles. Then workmen shovel the ice down a trapdoor into a giant underground vat. Here, the fragments melt and the water flows away into the sewage system of the city.

To hasten the drying of the concrete, the scrapers are fitted with heavy rubber squeegees which drag behind and wipe up the moisture. In thirty minutes, the ice, which took three hours to freeze, has disappeared and the concrete is practically dry. In some instances, a hockey game is played in the afternoon and then the floor is cleared and a prize fight is held in the evening.

It is this rapid-fire appearance and disappearance of the ice that makes the indoor game practicable for large cities. The system behind it is engineering's gift to hockey, a gift that is making the exciting game of spills and thrills enjoyed by increasing thousands of American fans.

DAUGHTER OF MME. CURIE CREATES A NEW ELEMENT

CREATION of an absolutely new radioactive element was reported recently to the International Conference on Physics at London by Mme. Irene Curie Joliot, daughter of the late Mme. Curie, and her husband Jean Frederic Joliot. The new element, called radionitrogen, was created by bombarding boron with alpha rays. After the bombardment, the transmuted boron emitted radium energy for fourteen minutes.

COPPER VASES KEEP FLOWERS FRESH LONGER

CUT flowers stay fresh longer in copper jars or vases, recent experiments have shown. Copper, minute quantities of which dissolve from the vase in the water, retards the growth of bacteria which cause flowers to decay, experimenters say in explanation.

HERE'S THE ANSWER

(Continued from page 59)

twenty-five to forty miles an hour while its whirling winds reach speeds of from 300 to 500 miles an hour.

Count 'Em And See

D. T., MEMPHIS, TENN. About three quintillion electrons flow through the average fifty-watt incandescent lamp every second it is lighted.

Sea Air and Ozone

J. L., BALTIMORE, MD. Although popular belief credits the bracing effect of a sea breeze to the ozone contained in the ocean air science proves otherwise. Tests have shown that little ozone is contained in either land or sea air.

Sound Speedier In Water

T. T., SALT LAKE CITY, UTAH. Strange as it may seem, sound travels four times faster through water than it does through air. In water, sound waves cover 4,780 feet in one second, while in air, at normal temperature, they travel only 1,089 feet a second.

Clinkers Not Stoker's Fault

Q.—WHEN clinkers form in a furnace, isn't it a sign that the fire is not being stoked properly?—K. D. C., Newark, N. J.

A.—NOT necessarily. Clinkers are merely fragments of ash that have been fused into lumps by the heat of the fire. Some kinds of coal leave an ash that is more fusible than that left by others.

Earth Like Onion

W. B. G., LOUISVILLE, KY. It has been estimated that the so-called "outer crust" of the earth is slightly more than twelve miles thick. This surface layer is one of four distinct shells enveloping the earth's 2,200-mile-diameter core.

Sulphuric Acid Popular

G. K. L., DOVER, N. J. Sulphuric acid rates next to water as the most-used liquid in the chemical industry.

Rocket Fuel

P. K., LOUISVILLE, KY. Gasoline and liquid oxygen form the fuel for most experimental rockets. The liquid oxygen is necessary to support the rapid combustion and the handling of it presents one of the major difficulties of rocket work. To keep it liquified, a temperature of 183 degrees below zero Centigrade must be maintained, making it necessary to use special containers. Above this temperature, the liquid oxygen boils vigorously, giving off large quantities of oxygen gas.

How Old Is Coal?

F. D., JR., NEW YORK, N. Y. It is believed that coal was mined and used by the Chinese over 2,000 years ago. Even at the present time, the coal fields of China are probably the largest in the world.

Air Pressure on Everest

J. U., BOSTON, MASS. At the top of Mt. Everest, some 29,000 feet above the sea, the air pressure is about four pounds to the square inch or about one-third the pressure at sea level.

Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

DOES YOUR CAR NEED NEW PISTON RINGS?

(Continued from page 60.

sumption. It had no power. You could hear the blow-by It had no compression, used lots of gas, and the spark plugs were always fouling. Still, the customer swore he never had to buy a quart of oil from one oil change to the next."

"How do you account for that?"

"Only one thing could cause it," Gus replied. "Gasoline was leaking down past the pistons just as fast as the oil was being burned, so it sort of struck a balance. After the first few hundred miles with new oil, that motor was being lubricated with a weak mixture of gas and oil, but the car owner didn't know that."

"YOU wouldn't think enough gasoline could get by the pistons to make that much difference," ventured Landon

Gus grinned. "You'd be surprised. Why, I've seen cars that were much worse than that One buggy passed so much gasoline that you just about had to bail the crankcase out to keep it from overflowing. You may not believe it but the crankcase mixture would gain as much as a quart in a hundred miles."

"Well, one thing sure, if a car uses lots of oil it's a pretty good sign it can stand a ring job, isn't it?" insisted Landon.

"Yes and no again. Stuck rings or rings with their gaps in line will run oil consumption up, to say nothing of what crankcase leaks will do. It's the same way with poor compression. Bad rings cause poor compression, but poor compression doesn't always mean that the rings are bad. A loose cylinder head, a bad gasket, worn valves, or wrong valve adjustment will kill compression just as fast as leaky rings.

"A few minutes ago you asked if fouled plugs meant worn rings. Sometimes they do, and sometimes they don't. Poor ignition or bad plugs will foul the points just as fast as oil leaking by the rings, and still I've seen plenty of oil-pumpers that never fouled a plug."

Landon wagged his head. "Gosh, at that rate it's pretty hard to know when a car needs new rings and when it doesn't."

"Oh, it's not so bad. Only you can't count too much on any one sign. When your car really needs new rings, you'll know it. The first sign of trouble will be when she loses power and maybe develops a bad miss at low speed. About that time you'll notice that you have to buy more gas than you used too, and chances are your oil bill will start to go up. Then you'll notice that your exhaust smokes, not just when you start in cold weather or when you speed up after coasting down a hid, but all the time."

"Is there any sense in trying to use heavier oil to make up for worn rings?" asked Landon.

"You can't make oil take the place of metal. The only thing a heavier oil will do is waste gas. Once the rings are worn nothing will do any good but a first-class ring job with new piston pins, a check-up on the connecting rods, new pistons and a cylinder refinishing if they're needed, and a general tightening up of the bearings."

BY THIS time Gus had finished his work on Landon's car and the owner sat idling the motor while Joe Clark pushed open the garage doors.

"You know," Gus sighed as Landon piloted his car out through the driveway. "I've sort of changed my mind about that fellow. If more owners were on the lookout for worn rings we'd have lots less trouble trying to put pep back into cars with scored cylinder walls, burned pistons, and battered bearings. That would save everybody a lot of grief."

HOW RADIO STARS HEAR THEMSELVES

(Continued from page 36)

sponsor after he had heard records made from broadcasts in the East. A story with a reverse twist comes from another studio. An advertising agency ordered records of a certain program. It wanted to play them for the sponsor to demonstrate how bad the feature really was.

To any list of unusual recording orders must be added one that helped a young dramatist break into the New York radio market. He had submitted script after script and they all came back. Some of them, he thought, had not even been read. So he went to a recording studio, had one of his skits turned into a record and sent this to the broadcasting company. It was accepted almost at once.

AMONG the radio stars, the best customers for the recording laboratories are Gladys Swarthout, Rudy Vallee, Lawrence Tibbett and Tom Howard. At one time, Jack Arthur was Number One customer. He was appearing on eighteen programs a week and had them all recorded.

Arrangers, the musical experts who prepare the scores for popular orchestras, are among the steadiest patrons of the laboratories. They have the programs recorded and then cut out their arrangements of the hit melodies to sell to other leaders. As there are thirty or forty of these crack arrangers in the game, their orders often keep the recording turntables spinning for hours at a time.

Ben Bernie is said to have originated another use for recorded orchestra programs. After every broadcast, for a time, he made it a practice to go over the records with his musicians, pointing out flaws in technique, until he had them letter perfect.

Similar sessions are now being held by some leaders before they appear on the air. In fact, "B.B.," or before-broadcast recording, is one of the fastest developing features of the work at the present time. Artists are making and recording test broadcasts as part of the preparation for a program. Tom Howard, for example, will never appear on the air without making a record beforehand to see that everything is O.K.

Several months ago, a family of noted musicians and singers were ballyhooed for weeks before they made their debut on the radio. Thousands of dollars were spent in advertising them. Then, their program was a flat failure. The radio clipped the higher cycles of their music and failed to carry the very feature which gave it its distinctive character in the concert hall. A few dollars spent for B.B. records would have shown just what listeners would hear and would have avoided the loss and disappointment that resulted.

IN CONTRAST, take the preparation Joe Cook made for his first appearance on the air. He worked for days at a time making test broadcasts and studying the records. By the time he reached the mike, he knew exactly how his program would sound and had developed a radio technique best fitted to his type of humor. And his first broadcast was a smash success.

Sometimes, for test records, experts use cheap gelatine disks. The only recommendation for them, however, is their low cost. They are temporary makeshifts and are unsatisfactory either for filing or for prolonged study.

What is ahead for radio recording? It is still in the early stages of its development. But its sensational rise in recent months has been an outstanding event in the broadcasting world. Already, it has gone far in producing a revolution in microphone technique which promises to bring better programs to the air.

LARGEST BRIDGE RESTS ON SUNKEN SKYSCRAPERS

(Continued from page 21)

two traffic levels. To the eastward, traffic will pass over a short length of viaduct and next over a cantilever bridge. Beyond it will cross five successive truss spans and finally a concrete viaduct. From Rincon Hill in San Francisco to the east shore of the bay the bridge will be eight and one-quarter miles long. It will cost $77,000,000.

The decks of the suspension bridges will be 214 feet above high water and the towers will rise into the air 505 feet. Towers of this height sway surprisingly in the wind and engineers have spent many days atop the towers peering down on large ruled squares of paper observing the movement. They have found that one tower will bend over three feet while loaded.

THE cables, far too heavy for any machine to lift, will be spun on the towers. Two cables will stretch from the anchorage on the San Francisco shore to the pile of concrete in mid-channel, whence another pair will reach to Yerba Buena. The method is much the same as that used by a spider in spinning his web. A shuttle wheel will carry a single loop of one-fifth-inch wire from one anchorage up over the towers and hook it into a steel eye in the anchorage opposite. The process will continue until the 17,464 wires in each cable are strung.

At each anchorage the wires will be separated into thirty-seven strands, each being fixed to an individual eye embedded in the concrete. The cables, as seen by a traveler on the bridge, will be twenty-eight and one-quarter inches in diameter, about twice as thick as the average telegraph pole.

Each shore anchorage, while not of the gigantic proportions of the central pier, contains enough concrete or rock to construct an Egyptian pyramid. The huge weight is necessary to withstand the terrific pull of the cables. Each cable will, it is estimated, exert a pull of 18,000 tons, a force sufficient to move a train of 250 loaded freight cars. Into the bridge will go enough steel and concrete to build all the large office buildings in downtown San Francisco. The timber used for false work and temporary shanties would raise enough dwellings to house a town of 15,000 population.

These figures refer only to the Bay Bridge. From the north side of San Francisco, another bridge is to cross the Golden Gate. Its central span, four-fifths of a mile between towers, will be the longest in the world.

IN ERECTING the south tower of this remarkable bridge, engineers were confronted by what seemed insuperable difficulties. Water at this point is 100 feet deep and the seven-mile-an-hour tide which sweeps in and out of the Gate sometimes rolls up waves twenty feet high. It was impossible to use ordinary methods of underwater construction and engineers had to resort to the unusually daring feat of sinking a "well" into water that is virtually open sea.

The well is an oval-shaped cofferdam, 750 feet wide along its longer axis. Built of steel sections bolted together, it rises from the bottom to a height fifteen feet above high water. Within the coffer dam, workmen pursue their tasks undisturbed by the rushing tides of the Golden Gate.

The cofferdam is located 1,100 feet from the southern shore of the Golden Gate, and is connected with the land by a construction pier over which workmen and materials can be transported directly to the work.

This pier and tower, when completed, will measure 846 feet from bedrock to the tip of the steel work, making it one of the world's tallest structures.

SOLVING SECRETS HIDDEN IN WOOD

(Continued from page 15)

stumps which are supposed to be the remnants of trees which, when still alive, marked a line of survey. If the surveyors had witnessed a point by means of a buried pine tree and the tree died later, by sending in part of the stump one might gain information as to whether the stump in dispute was really pine or not.

"Several years ago, some specimens were received which had been taken from the bottom of a railroad cut fifty feet deep. This wood, which according to geologists had been covered up by a glacier over 50,000 years ago, was still sound enough to be identified as spruce. It had been badly crushed but the cell structure was still plainly visible under the microscope."

MUSEUMS sometimes send in fragments of old wood. Recently Miss Griffin received a sliver of wood from an Egyptian mummy case estimated to be 3,000 years old. The wood was identified as from the fig tree of Biblical fame. In another instance, a badly decayed piece of wood from an Indian canoe which had been recovered from Lake Minnetonka, in Minneapolis, was submitted. By cutting off the end of the piece with a sharp knife, Miss Griffin was able, with the use of a hand lens alone, to identify it as white oak. Because their structure in cross sections is so distinctive, oaks, elms, maples, and some other varieties can be identified without placing a section under a microscope.

A great deal of this work, however, requires the use of a high-powered microscope with which the shape, arrangement, and configuration of the cells of which wood is composed can be ascertained. The microscope frequently reveals decided differences in wood which could not be suspected from ordinary observation.

The number of wood specimens submitted to the Forest Products Laboratory for identification varies from day to day and from year to year, but there is hardly a day when the Laboratory does not receive a specimen of some sort or other. As an indication of the extensive use already made by the public of the wood identification section, the smallest number received in one year has been 1,000 specimens. In the month of September, 1918, when the testing of war materials was at its height, over 3,000 pieces were passed upon. This is the record month in the history of the office.

Often the wood technologist is called upon to settle disputes of a commercial nature. During the building of a railroad line, the railroad's contract called for white oak ties, with strict instructions for every red oak tie to be thrown out. Acting upon these instructions, and believing that they were detecting the forbidden red oak ties, the inspector threw out almost every other tie. Finally, several of the rejected ties were sent to the Forest Products Laboratory. In a few days the reply came back that the specimens had been carefully examined, and that in each case they were of white oak.

ON one occasion a mail-order house requested examination of a large number of wooden articles in order to be sure that these articles had been correctly described in its catalogue.

Small slivers of wood from various pieces of furniture are frequently sent in for identification. The best method of getting a sample without defacing the piece of furniture is to take a sliver of wood from under the base.

Pipe-smokers often want to make sure that their pipes are of real French briar, for certain woods, particularly mountain laurel, are sometimes used in place of French briar which they closely resemble. Slide rules and other scales supposed to be made of boxwood are often submitted. These are sometimes made of species which are coarser grained or otherwise inferior to genuine Turkish boxwood. Wooden portions of airplanes which have had disastrous accidents are also submitted.

Landscape architects, in restoring old gardens, have often made use of the wood identification service. A piece of wood from an old tree found on land that had once been part of Washington's Mount Vernon estate was sent in, and found to be honey locust.

LAST March the Laboratory received for identification four pieces of wood taken from the buildings which are duplicates of the famous Hooden Temple at Niji, Japan, built on the Wooded Isle in Jackson Park, Chicago, for the 1893 World's Columbian Exposition. These were being restored. All of the wood parts used in the original construction of these buildings had been fabricated and assembled in Japan, then carefully marked and shipped to Chicago, and reassembled in Jackson Park by the same workmen. The experts at the Forest Products Laboratory were able to state that the first three specimens were of a species of true fir, while the other specimen was of Japanese sugi wood.

Knute Reindahl, a noted violin maker living in Madison, Wis., made a violin which he later presented to Fritz Kreisler. He wanted to obtain more wood of the kind he had used for that violin, and on submitting some remnants of it to the Laboratory, learned that it was Sitka spruce—a species highly esteemed for fine structural uses, as in airplane construction, but not hitherto considered as suitable for violin making.

Curiosity is often the motive that prompts people to send in wood specimens. A tree growing on the lower of the courthouse in Greensburg, Indiana, has attracted so much attention that many people have sent in small branches that the wind has broken off. The tree, fifteen feet in height and with a trunk four inches thick, has been thriving in its strange location for the last thirty-five years, and is said to be unparalleled in the world. Supposed to be maple, it has been identified as poplar at the Forest Products Laboratory.

A stick which had been fashioned into a whip was sent to the Laboratory, and was identified as wood from the Lacebark tree. This is a small tree or shrub growing chiefly on limestone rocks throughout the West Indies. The inner portion of the bark consists of many thin laminations which readily separate and are strikingly similar to fine lace.

EVEN fashion has an influence on the kinds of articles received for examination. Wooden heels for women's shoes are often received in Miss Griffin's mail. She explains that maple is considered the best wood for heel purposes, although birch is occasionally used. The requirements for wood used in shaped heels are extremely exacting, and sometimes the manufacturer has difficulty in shaping it. In such cases he sends the material in for identification, in order to determine whether he has actually received the kind of wood he ordered.

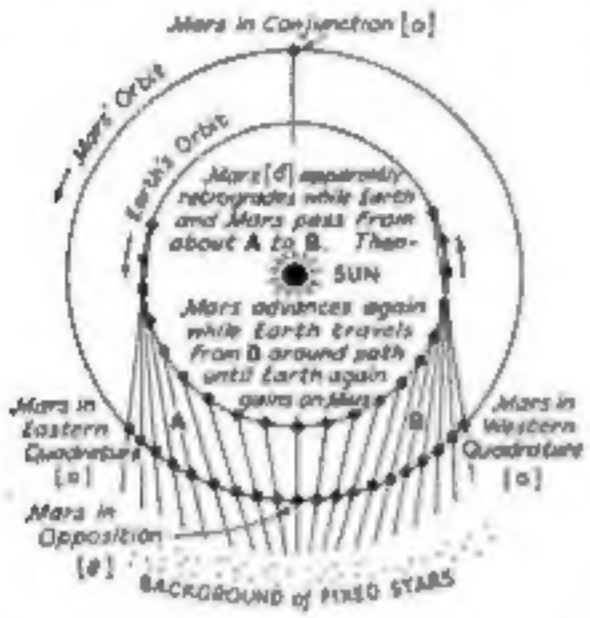
Both Koehler and Miss Griffin find that wood identification has a fascinating variety. Koehler's intensive research in wood usually keeps him so busy that he has little time for outside interests, but sometimes when his day's work at the Laboratory is over he returns to the fully equipped basement workshop in his home, where his hobby is—to make things of wood!

A New Planet Finder You Can Make at Home

(Continued from page 55)

crosses the orbit of the earth, and mark the point with a pin. You now have the position of the earth in its orbit on May 1, 1935. It will be at 220 degrees.

Now note on the degree scale, at the bottom edge of the drum, the number which is directly under the Venus dot in the position it took on the zodiac after counting off 120



Why Mars "loops the loop." As the earth passes Mars, that planet appears to back up

days (twelve ten-day intervals) from its position on January 1st. Follow this same numbered degree line toward the sun, just as you did before, until it crosses the orbit of Venus. Mark this crossing with a pin. It will be at 136 degrees.

One more step and you will have the position of Venus which you seek. To find it, look straight down into the bottom of the cup, at the same time holding a ruler across the top. Move the ruler until it connects the points marked with the pins. Then follow the edge of the ruler with your eye, from the pin mark on the earth's path through the pin mark on the path of Venus, and beyond, until the ruler edge meets the edge of the transparent drum. While still sighting this point on the drum, bring the Venus ring around until the white Venus dot is in line with the point where the ruler meets the drum's edge. This shows you the place in the zodiac where you should look for Venus on May 1, 1935. It should be in the constellation Taurus a few degrees east of the bright star Aldebaran, which is the eye of the bull.

By counting off on a yearly calendar the correct number of days from January 1, 1935, and then moving each planet dot the equivalent number of ten-day intervals (or yearly intervals in the case of Jupiter) you can locate the *heliocentric* position of any planet at any time in the future. And when the heliocentric position is found, the *geocentric* position (the *apparent* position as seen against the constellations from the earth) is easily found, as already indicated, by making a line with pins and ruler.

If you carry out this operation with the planet Mars for each of the fourteen ten-day intervals from February 1, 1935, to May 10, 1935, and mark down the geocentric positions upon a chart of the constellation Virgo, or the Virgin (see one of the diagrams) you will note that the apparent position of Mars in the constellation travels westward instead of eastward during this entire eighty-one days. Then it becomes stationary, and moves forward until it has regained the point from which it "retrograded." This point will be regained in about sixty-three days. Accordingly, Mars spends 144 days, or four and eight-tenths months in forming a backward and forward loop. The rest of our solar year it progresses steadily eastward among the zodiacal constellations.

A glance at the diagrams will explain the retrograde motion of Mars easily. Its orbit is outside that of the earth, and the ruddy planet takes two of the earth's years to traverse its circuit. Accordingly, the earth must catch up with and pass Mars once during each circuit of twelve months.

At these times, the same effect occurs which is seen when a railroad train in which you are riding passes a slower train moving in the same direction on a parallel track. As your train catches up with and passes the other, the slower train seems to stop, and then to move backward across the landscape behind it.

Think of Mars and the earth as trains on parallel tracks. As the earth catches up with and passes Mars, the latter seems to go slower and slower (relative to its background constellation of the zodiac) and eventually stops. At the centre of this motion the almanac describes the event in the words, "Mars in opposition," which simply means that Mars, the earth, and the sun are in line, with the sun and Mars in opposing positions.

But, as the faster-moving earth continues on its track, Mars apparently falls behind or "retrogrades" on its track. It seems to us to be moving *backward* among the stars along the ecliptic, or what we call the race track of the planets.

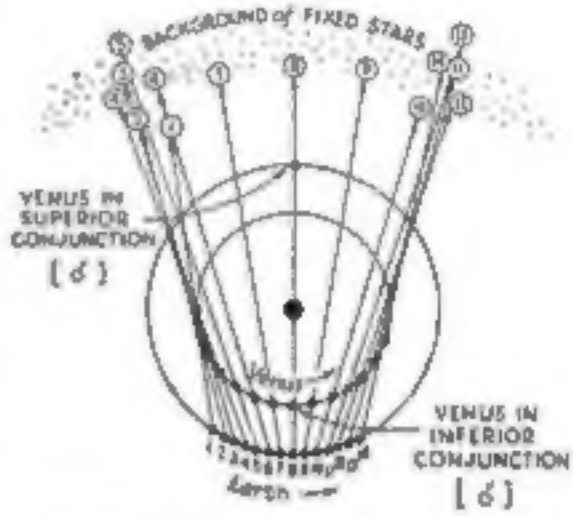
The almanac records the beginning of this movement in the words: "Mars stationary," and its end, about eighty days later, again by the words: "Mars stationary." After this second stationary point is reached and passed, Mars again moves forward among the zodiacal constellations until the same situation occurs again as the earth again catches up with and passes its neighbor planet in their perpetual race.

This same loop is also formed by the path of Venus, except that in this case Venus is the faster train, and (because its orbit lies within the earth's) Venus gets in line with the sun and disappears for a time in his blaze of light. A moment's study of the diagram will make it clear how Venus, while getting into and out of line with the earth and sun, changes from an "evening star" (visible after sunset) to a "morning star" (visible before sunrise). It also explains why Venus is never seen more than forty-seven degrees from the sun.

During 1935, Venus will become stationary and begin its backward movement about August 10, and will retrograde for forty-three days. Then, on September 27, it will again become stationary and resume its direct motion for the rest of the year.

THE diagrams showing the retrogression of Mars and Venus indicate, in addition, the symbols and terms used in almanacs to indicate the different positions and motions of the planets.

These symbols form a sort of "astronomers' shorthand"—a brief, convenient way of describing the activities of Old Sol's family throughout the year. This information is given in almanacs under the heading "Planetary Configurations," and it is interesting to be able to understand the symbols and visualize at once the cosmic happenings for which they stand. With this knowledge, you can avail yourself of the information to be found in almanacs and other sources.



How Venus changes from morning to evening star and why it is always seen near the sun

Mercury is here left out of consideration, because it moves so rapidly and is in view such a short time after sunset and before sunrise that many people never see it at all. However, if you wish to follow this "artful dodger" of the sky, any almanac will tell you when to watch. Look for it on the date opposite the words, "Greatest Elongation (East and West). "East" in this connection means (rather strangely) in the *sunset* sky; and "west" means in the *sunrise* sky.

Here are some of the other characteristics by which you will be able to recognize the various planets:

Venus is brighter than any fixed star or other planet. Its color is dazzling white. It is never visible all night and never appears higher in the sky than forty-seven degrees from the setting or rising sun. It moves more rapidly along the zodiac than any other planet except Mercury.

Mars is of a distinctly reddish hue, and is very bright at and near "opposition." It may be seen at any point along the diurnal arc of the sky, and can be seen all night at its opposition with the sun.

JUPITER is the brightest planet except Venus (or Mars during a close opposition). Its white color, however, always distinguishes it from Mars. It moves through only one constellation a year, and can be seen all night when in opposition with the sun.

Saturn is of a dull yellow color, and is never as bright as the other naked-eye planets. It moves through only one constellation in two years, and can be seen all night when in opposition with the sun.

Uranus and Neptune can be followed only if you have a telescope with which to observe them.

Venus and Mercury are "evening stars" from "superior conjunction" through "eastern elongation" to "inferior conjunction." They are "morning stars" from "inferior conjunction" through "western elongation" to "superior conjunction."

Mars, Jupiter, and Saturn, are "evening stars" from "opposition" through "eastern quadrature" to "conjunction." They are "morning stars" from "conjunction" through "western quadrature" to "opposition."

Path of Mars in its loop from January 1 to July 10, 1935. The dots are ten-day intervals

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